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ORIGINAL ARTICLES

The Effects of Occlusion with Various Pressures on the Blood Flow in the Lower Extremities. Jean C. Terrier, M. D.; Khalil G. Wakim, M.D., and Frank H. Krusen, M.D. 391

A Coordinated Program of Physical Therapy and Occupational Therapy in a General Hospital Physical Rehabilitation Program. Max K. Newman, M.D., and Harriet Barbara Jewett, O.T.R. 395
Discussed by Dr. Herman L. Rudolph, M.D.

Progress in Use of Ultraviolet Radiations. William T. Anderson, Jr., Ph.D. 402

Present Status of Fever Therapy. William Bierman, M.D. 408

The Construction, Calibration and Use of Thermocouples for Measuring Body Temperature. W. W. Tuttle, Ph.D., and C. D. Janney, Ph.D. 416

Committee Reports, American Congress of Physical Medicine 422

Editorial 423

Medical News 429

Book Reviews 431

Physical Medicine Abstracts 435

Preliminary Program. Twenty-Sixth Annual Scientific Session and Instruction Course, American Congress of Physical Medicine 437

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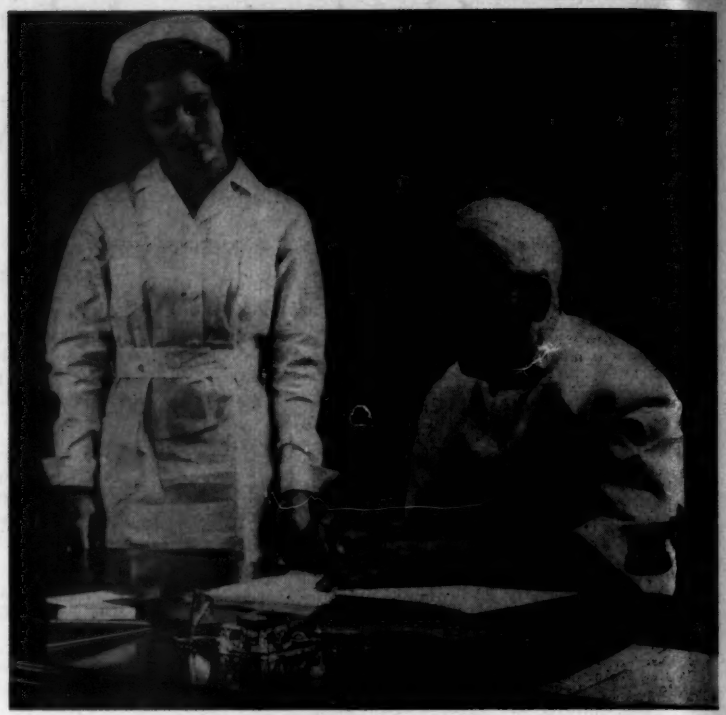

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THE EFFECTS OF OCCLUSION WITH VARIOUS PRESSURES ON THE BLOOD FLOW IN THE LOWER EXTREMITIES

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Alternating periods of congestion and release, as produced by intermittent interruption of the venous blood flow, are believed by some authors[1] to produce a favorable trophic effect on extremities with impaired arterial inflow. The physiologic basis for this effect has been stated to be the reactive hyperemia which, according to observations first made by Lewis and Grant,[2] follows a period of venous occlusion. Lewis and Grant studied the effects of single periods of constriction on the blood flow in human extremities by means of a water displacement plethysmograph. Applying constriction at about diastolic pressure for periods varying between ten and fifteen minutes, they found that the blood flow increased three to four times after release and that the increase of flow lasted for several minutes. Collens and Wilensky[1] reported many cases in which clinical improvement resulted from the use of intermittent venous occlusion in treatment of peripheral vascular diseases. They advocated twelve hours a day of treatment, with a pressure of 30 to 60 mm. of mercury, and a rhythm of two minutes of occlusion alternating with two minutes of release. They stated that release of obstruction to venous flow seems to be associated with an active vasodilation. The same authors[3] observed also a rise of cutaneous temperature of as much as 3 degrees fahrenheit and an improvement of the oscillometric readings after one hour of intermittent venous occlusion.

In their studies on the effects of intermittent venous occlusion, de Takats and associates[4] reported an increase of amplitude of the pulsations, which started immediately after release of the pressure and lasted for two to four minutes. This was accompanied with a decrease of the systolic and diastolic pressures. In another communication, de Takats, Beck and Roth[5] stated that increased blood flow and increased vascular capacity are by no means synonymous. Increased blood flow could hardly be expected after one treatment with intermittent venous occlusion, but gradual stretching of the vascular bed was obvious from oscillometric readings.

1. Collens, W. S., and Wilensky, N. D.: Use of Intermittent Venous Compression in Treatment of Peripheral Vascular Disease; Preliminary Report, Am. Heart J. 11:705 (June) 1936.
2. Lewis, Thomas, and Grant, Ronald: Observation Upon Reactive Hyperaemia in Man, Heart 12:73, 1925.
3. Collens, W. S., and Wilensky, N. D.: The Treatment of Peripheral Obliterative Arterial Diseases by the Use of Intermittent Venous Occlusion: A Report of the Results of Twenty-Nine Cases, J. A. M. A. 107:1960 (Dec. 12) 1936.
4. de Takats, Geza; Hick, F. K., and Coulter, J. S.: Intermittent Venous Hyperemia in the Treatment of Peripheral Vascular Disease, J. A. M. A. 108:1951 (June 5) 1937.
5. de Takats, G.; Beck, W. C., and Roth, Eunice A.: The Neurocirculatory Clinic; a Summary of Its Activities: I. Peripheral Vascular Disease, Ann. Int. Med. 13:957 (Dec.) 1939.

Allen and McKechnie[6] could not observe any significant change of the cutaneous temperature of their patients after two hours of intermittent venous occlusion at a pressure of 30 to 60 mm. of mercury, two minutes of pressure alternating with the two minutes of release. They concluded that, in their experience, intermittent venous occlusion did not cause vasodilatation.

Linton and associates[7] studied the effects of venous occlusion on the arterial inflow in dogs by means of the Rein thermostromuhr. They suggested that the improvement of circulation in the extremities of patients treated by intermittent venous occlusion is to be at least partially explained by an increase of the arterial inflow during the period of venous occlusion. They remarked that reactive hyperemia plays a minor role, if any. Wright[8] stated that in some instances it was felt that intermittent venous occlusion had been harmful. One of us (Krusen)[9] summarized the question of intermittent venous occlusion by stating that clinical improvement is obtained in a sufficiently high percentage of cases to warrant consideration of its use; yet the whole problem of its value is still much confused, and more studies are necessary.

The present study was made in order to investigate the effects on the blood flow in the lower extremities: first, of single periods of five minutes of occlusion at a pressure of 40, 80 or 120 mm. of mercury; and, second, of periods of one hour of intermittent venous occlusion, applied at a rhythm of three minutes of pressure alternating with three minutes of release.

Methods[10]

The measurements of blood flow were taken by means of the venous occlusion plethysmograph. The plethysmographs were applied to each of the lower extremities, including the foot and leg up to 1 inch (2.5 cm.) below the tibial tuberosity. The collecting cuffs were placed between the knee and the upper end of the plethysmograph and were inflated to a pressure of 60 mm. of mercury for each reading of blood flow. The changes of volume in the plethysmograph were recorded optically by use of compensating spirometers as explained by Berry and associates.[11] Control values of blood flow were established at the beginning of each experiment, after the subject had been given sufficient time (about twenty minutes) for adaptation to the plethysmograph and to the surroundings.

For the investigation of the effects of single periods of constriction, the collecting cuffs used in the plethysmographic determination of the blood flow were employed for occlusion at the same position. Pressures of 40, 80 or 120 mm. of mercury were applied to one extremity for periods of five minutes each. The contralateral extremity was employed as control. Measurements of blood flow were taken immediately after each release and every minute during the following five minutes.

For the investigation of the effects of intermittent venous occlusion, a standard type of commercial rhythmic constrictor which is approved by the Council on Physical Medicine of the American Medical Association was used. This constrictor automatically inflates and deflates a rubber cuff placed above the knee. Intermittent occlusion was applied to one extremity for one hour, three minutes of constriction with a pressure equal to the diastolic pressure alternating regularly with three minutes of release. Measurements of blood flow were taken on the treated extremity during the three minutes of release following the first and the last period of constriction. Final measurements of blood flow were taken on both extremities five minutes after the end of the treatment.

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6. Allen, E. V., and McKechnie, R. E.: Effect of Intermittent Venous Occlusion on the Circulation of the Extremities; Study of Skin Temperature, J. Lab. & Clin. Med. 22:1260 (Sept.) 1937.
7. Linton, R. R.; Morrison, P. J.; Ulfelder, Howard, and Libby, A. L.: Therapeutic Venous Occlusion; Its Effect on the Arterial Inflow to an Extremity, as Measured by Means of the Rein Thermostromuhr, Am. Heart J. 21:721 (June) 1941.
8. Wright, Irving: Conservative Treatment of Occlusive Arterial Disease, Arch. Surg. 40:163 (Feb.) 1940.
9. Krusen, F. H.: Physical Medicine: the Employment of Physical Agents for Diagnosis and Therapy, Philadelphia, W. B. Saunders Company, 1941, p. 682.
10. The excellent technical assistance of Mr. Adrien N. Porter is gratefully acknowledged.
11. Berry, M. R.; Baldes, E. J.; Essex, H. E., and Wakim, K. G.: A Compensating Plethysmokymograph for Measuring Blood Flow in Human Extremities, J. Lab. & Clin. Med. 33:101 (Jan.) 1948.

Two series of observations were carried out on 8 normal persons and on 3 patients whose circulation was moderately impaired by arteriosclerotic disturbances. All the subjects had blood pressures within the normal range except 1 patient who had hypertension with a systolic blood pressure of 215 mm. of mercury and a diastolic blood pressure of 118 mm.

Results

A. In the first series of observations, the effects on blood flow of a single period of five minutes of constriction with a pressure of 40, 80 or 120 mm. of mercury were investigated.

Nineteen observations at 40 and 80 mm. of mercury and 18 observations at 120 mm. were made on 9 subjects, 2 of whom had a moderate degree of arteriosclerosis. Table 1 gives the average changes of blood flow in each observation during the five minutes following release of pressure.

TABLE 1. — *Percentage Change of Blood Flow in Lower Extremities After Five Minutes of Occlusion at Various Pressures.*

Observation	Percentage Change At 40 mm. Hg.	At 80 mm. Hg.	At 120 mm. Hg.
1	— 6	—17	— 8
2	— 5	—24	—39
3	—13	— 8	—29
4	—21	—43	—33
5	—30	—28	—23
6	+31	+15	—11
7	+ 5	—19	—16
8	+18	—10	+18
9	+11	+ 7	—13
10	—26	+ 8	+25
11	—17	—27	—28
12	+20	+49	+ 9
13	+32	+66	+39
14	+58	+46	+36
15	+ 5	— 8	— 1
16	—14	— 8	+ 9
17	— 5	—18	—17
18	+ 7	0	..... *
19	—20	—38	—21
Average	+ 2	— 3	— 6

* No observation.

If only the increases of +15 per cent or more and the decreases of —15 per cent or more in absolute amount are considered as significant:

1. There was an increase of blood flow in 5 of 19 observations after a pressure of 40 mm. of mercury (maximal increase +58 per cent), an increase in 4 observations after 80 mm. (maximal increase +66 per cent) and an increase in 4 of 18 observations after 120 mm. (maximal increase +39 per cent).

2. There was a decrease of blood flow in 5 of 19 observations after a pressure of 40 mm. of mercury (maximal decrease —30 per cent), a decrease in 8 observations after 80 mm. (maximal decrease —43 per cent) and a decrease in 8 of 18 observations after 120 mm. (maximal decrease —39 per cent).

3. There was no significant change of blood flow in 9 of 19 observations after a pressure of 40 mm. of mercury, in 6 observations after 80 mm. and in 7 of 18 observations after 120 mm.

4. The average change of blood flow in all observations was +2 per cent after a pressure of 40 mm. of mercury, —3 per cent after 80 mm. and —6 per cent after 120 mm. These average changes of blood flow are decidedly insignificant.

B. In a second series of observations, a study was made of the effects of one hour of intermittent venous occlusion, applied with a pressure equal to diastolic pressure at a rhythm of three minutes of pressure alternating with three minutes of release.

Twelve observations were made on 4 subjects, 3 of whom had a moderate degree of obliterative arteriosclerosis.

Table 2 gives the percentage changes of blood flow in the treated extremity after the first and after the last period of constriction and the final changes in both extremities five minutes after cessation of treatment.

Considering as significant changes only the increases of +15 per cent or more and the decreases of —15 per cent or more in absolute amount, one can summarize the results as follows:

1. The data obtained from 12 observations after the first period of occlusion and 12 observations after the last period of occlusion show that there was an increase of blood flow in the treated extremity in only 2 of

TABLE 2. — *Percentage Change of Blood Flow in Lower Extremities During and After One Hour of Intermittent Occlusion at a Pressure Equal to the Diastolic Pressure of the Subject.*

Observation	Percentage Change In Treated Leg			In Untreated Leg
	After First Single Occlusion %	After Last Single Occlusion %	Final Change %	Final Change %
1	—21	—26	—25	+18
2	—15	— 7	+22	+31
3	—15	—24	—27	+38
4	—14	—24	— 5	+17
5	—12	— 4	0	—13
6	—23	—23	— 4	— 2
7	—15	+ 7	+ 9	+14
8	+53	0	+35	—24
9	+22	0	— 6	0
10	— 2	—16	— 4	+ 8
11	—18	—32	— 8	— 2
12	—35	—15	—42	+24
Average	— 8	—14	— 5	+ 9

the 24 observations (+22 per cent and +53 per cent). In 14 observations there was a decrease of blood flow (maximal decrease — 35 per cent). In 8 observations there was no significant change. The average change of blood flow in the treated extremity after the first and after the last period of constriction was —11 per cent.

2. In 2 of 12 observations there was a final increase of blood flow in the treated extremity (+22 and +35 per cent). In 3 observations there was a decrease (—25 per cent, —27 per cent and —42 per cent). In 7 observations there was no significant change. The average final change of blood flow in all the observations on the treated extremity was —5 per cent, certainly an insignificant change.

3. In 5 of 12 observations there was a final increase of blood flow in the untreated extremity (maximal increase +38 per cent). In 1 observation there was a decrease (—24 per cent). In 6 observations there was no significant change. The average final change of blood flow in the untreated extremity was +9 per cent.

Summary and Conclusions

The effects of a single period of venous occlusion for five minutes, with pressures of 40, 80 and 120 mm. of mercury, on the blood flow in the lower extremities of normal and arteriosclerotic subjects have been investigated.

After release of the occlusion with 40 mm. pressure, there were as many observations with decrease of blood flow as there were with increase. After release of the occlusion with 80 and with 120 mm. pressure, there were more observations with decrease than with increase of blood flow in either case.

In another series of observations a study was made of the effects on blood flow of intermittent venous occlusion (three minutes of constriction with a pressure equal to diastolic pressure alternating with three minutes of release) for one hour. The average final change of blood flow in all the observations was —5 per cent in the extremity treated with intermittent occlusion and +9 per cent in the contralateral extremity, which was used as control. Neither change was significant.

From the foregoing findings the conclusion can be drawn that under the conditions of our study a short period of occlusion for five minutes or intermittent occlusion for one hour with various pressures does not seem to have any significant effects on the circulation in the lower extremities.

A COORDINATED PROGRAM OF PHYSICAL THERAPY AND OCCUPATIONAL THERAPY IN A GENERAL HOSPITAL PHYSICAL REHABILITATION PROGRAM *

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DETROIT

With the close of World War I, rapid strides in the use of physical agents in treatment of war injuries were evident. A rebirth of the specialty of physical medicine occurred, and efforts toward rehabilitation were noted. During World War II, Great Britain was required to return its damaged fighting staff to combat as quickly as possible; consequently it developed a program of rehabilitation. Our country followed suit with the inception of the service convalescent training program in 1942. Because of the unusual success of this program, the Army Air Force initiated it in all its associated hospitals.

During the past two years the Veterans Administration has followed this development with a most complete program. Beginning with 25 physiatrists, 102 physical therapy technicians and 115 occupational therapists, the present staff now consists of a national chief of rehabilitation, 81 physiatrists, 531 physical therapy technicians, 432 occupational therapists, 300 physical

* Read at the Twenty-Fifth Annual Session of the American Congress of Physical Medicine, Minneapolis, Sept. 3, 1947.

education instructors, 407 instructors in manual arts and 306 specialists in corrective physical rehabilitation. This is a splendid program, directed toward war injuries, under official directive and with unlimited funds, endeavoring to do the greatest good for the greatest number and restore the fighting manpower front.

As war fades, the problem becomes a community one, with the veterans and civilians impregnated with ideas of rehabilitation. Service physicians have returned with altered ideas of hospital procedure, one of which is the great value of restorative medicine. By force and necessity, civilian hospitals and staffs are now having the problem thrust upon them, and they should be ready and available for these problems of rehabilitation.

The recent war years have indicated that certain general facts make more of medical practice than the ordinary curing of disease by medical or surgical means; restorative medicine has now become a third force in therapeutic procedure. A well organized over-all rehabilitation program reduces convalesence to a minimum and leads to the attainment by the patient of maximal functional capacity. At the present time about eight million males of working age are totally disabled and need vocational rehabilitation. About 350,000 persons are permanently disabled by accident every year. Both old and young can be returned to some degree of productivity, as was demonstrated during the recent past. In a group of 130 World War I veterans in a Veterans Administration Hospital in Minneapolis, many of whom had been hospitalized more than ten years, 25 have been rehabilitated so that they have been discharged from the hospital and are employed; 40 others have been returned to their homes capable of doing light work; 30 are ambulatory in the hospital, and 25 others are able to take care of their own needs, with only 10 that have failed to show worth while improvement. Consider the savings to the government in millions of dollars when this program is universally adopted. The same pattern translated into civilian hospitals began at the New York Hospital for the Crippled and Disabled, where it has been demonstrated that physical and vocational rehabilitation can be accomplished.

Further to develop this program, the Vocational Rehabilitation Amendment of 1943 was passed to aid in the peacetime program of rehabilitation. The nine point program includes: (1) location of persons in need of rehabilitation; (2) physical and vocational diagnosis; (3) vocational guidance; (4) medical, surgical and prosthetic services; (5) physical and occupational therapy and psychiatric services; (6) vocational training; (7) financial assistance; (8) placement in employment, and (9) follow-up on performance in employment.[1]

The problem of a general hospital to include a program of rehabilitation is great, mainly because adequate departments of physical medicine have not been universally established. Only a handful of physicians have been adequately trained in the use of physical agents, rehabilitation, vocational guidance and advisement services. Still inadequate are the members of physical and occupational therapy whose contribution is of utmost importance in attainment of the objectives of a rehabilitation program. The Baruch Committee on Physical Medicine has made available a report[2] showing the application of military experience to civilian practice in restorative medicine. A model center has been designed outlining the cost, procedures, organization, component parts and relationship to the program and to allied groups

1. Shortly, M. J.: War and Post-War Rehabilitation of Handicapped Persons, Physiotherapy Rev. 24:61 (March-April) 1944.
2. Baruch Committee on Physical Medicine: War and Post-War Rehabilitation and Reconditioning, (Dec.) 1944.

and the community. While ideal in its aim, it still leaves the burden of development on the average staff of the average general hospital or public agencies. Hence, the purpose of this paper — an effort to outline the problems and procedures of the average general hospital, with its varied short term patients, lack of funds, few technicians and little space, rarely a physician trained in physical medicine in a program of acute and chronic rehabilitation. It soon becomes evident that each hospital requires an individualized program, depending on the type of patients, the size of the community and the general interest of the public and the medical practitioners.

The physical medical measures employed need merely a reiteration: heat, light, massage, exercise and occupational therapy. Their value lies in the correction of the pathologic-physiologic processes inherent in the abnormalities of the individual patient. Most important is that of exercise and special exercise (namely, occupational therapy). Snow[3] has outlined a comprehensive program of details to be observed in the therapeutic exercise procedures: (1) exercises to enhance tissue drainage and improve circulation, (2) exercises to improve range of joint function, (3) exercise to improve muscle power, (4) exercises to preserve function and preclude atrophy, (5) exercises to improve coordination, (6) exercises to step up metabolism and (7) exercises to improve posture.

The plan we follow concerns itself with the usual types of patient admitted to a general hospital. The departments of physical medicine and occupational therapy are conveniently located for inside and outside transportation, so as to permit easy access for patients. Our consultant group, consisting of the neurologist, neurosurgeon, psychiatrist, orthopedist, urologist, internist and physiatrist and the medical associates (social worker, technicians and vocational guidance counselor), meets monthly to discuss procedure for the patients requiring special consideration. Close cooperation with the social agencies provides a fuller program of participation for the chronic and permanently disabled patient. Prevocational training and sheltered workshop surroundings are provided by the many state and city agencies. Reemployment in industry has been accomplished by direct contact with hiring personnel. The Ford Motor Company represents a typical example of cooperation; they currently employ about 10 per cent of handicapped workers.

The technical staff consists of a nurse physical therapist, a physical education physical therapist, a physical education instructor, an occupational therapist and a physiatrist. The physical education instructor deals only with normal tissue, whereas the others deal with the abnormal tissues. In this way, a paraplegic patient, for example, can be physically rehabilitated in the trunk and upper extremities, while special coordinated physical procedures are applied to the paralyzed lower extremities, utilizing to the fullest the special abilities of each technician. The physical therapist encourages cooperation and an intelligent interest of the patient during the application of physical procedures for their therapeutic effect upon diseased tissues. The occupational therapist plans activities which bring into action the part or parts of the body that require therapeutic exercise. Physical therapy is given in the early stages and is accompanied with occupational therapy as soon as active motion is indicated.

The physical therapy department is housed in one large room, partitioned off with curtains sliding on rods. This arrangement permits teaching demonstrations when necessary and also lends itself to group exercise training

3. Snow, William B.: The Problem of Rehabilitation in Civilian Medical Practice, M. Clin. North America 29:807 (May) 1945.

of the patients. Special communicating rooms house special equipment for diagnostic procedures and exercises procedures. In this way a constant temperature room is available for study of peripheral vascular and nerve injuries. The occupational therapy department is a complete one in close approximation to physical therapy. The staff is integrated and in close cooperation with the local university medical school and so offers clinical training for prospective occupational therapists under proper supervision. Further to aid and rehabilitate, the physiatrist holds weekly conferences with the referring physicians. By outlining the proper physical and occupational therapy procedures to be carried out in the home, the inadequacy of funds or insufficient departmental visits is obviated. The home program is most interesting and helpful to the patient. Hence we are able to fulfil the requirements for a good department of civilian medical rehabilitation: a properly trained staff, physical equipment, adequate treatment, post-treatment training at home and vocational follow-up.

Specific Rehabilitation in the Hospital Program

The postsurgical program has been greatly neglected, and, as a consequence, the evils resultant on such neglect are still rampant — namely, atalectasis and hypostatic pneumonia, embolism and venous inflammation of the lower extremities. (The postmedical program, applicable to patients with cardiac conditions, pneumonia, arthritis and peripheral vascular diseases, is rarely considered in early ambulation.) Leithauser, long a proponent of early ambulation for surgical patients, has reduced postoperative complications to a minimum by early ambulation. Basically, his program serves to provide adequate exercise to the vessels and muscular structures of the lower extremities and so obviates the stasis and pressure so important in venous thrombosis. Our own program has been developed for both medical and surgical patients and affords a satisfactory exercising of basic needs of muscle groups. The frequency of exercise depends upon the patient's medical or surgical conditions, but generally the groups of exercises are repeated at least three times daily, three to ten times for each exercise. The bedclothes need to be removed only at the beginning of exercise to be sure of the proper movements on the part of the patient. The exercises are under supervision of the supervisor nurse, with the assistants watching, the first time the patient is exercised. The patient assumes the optimum position of relaxation, lying on the back, with hands near the head and elbows flexed on the bed, feet separated and the toes straight up. The following list of exercises is then carried out:

Exercise 1. — Feet and Legs: (1) Flexion and extension of toes; (2) flexion and extension of ankles; (3) circumduction of feet, with motion at ankles and midtarsal joints clockwise and counterclockwise; (4) toeing in and toeing out by rotating legs internally and externally. These exercises maintain the integrity of the arches by action on the foot flexors and the anterior and posterior tibial muscles and achilles tendon.

Exercise 2. — Thighs: (1) Quadriceps setting; (2) flexion of knees and hip, sliding foot on mattress toward buttocks, both legs reciprocating in action; (3) abduction and adduction of the thighs with the soles together; (4) crossing one leg over the other and pulling cephaled with the opposite hand and then repeating the opposite side. These exercises maintain the integrity of the hamstrings, quadriceps, abductor and adductor muscles and the fascia lata.

Exercise 3. — Trunk: (1) Curved side stretch, with one knee flexed and the pelvis pushed to the opposite side; (2) with the knees flexed and feet on bed, obliteration of lumbar curve. These procedures exercise the large trunk muscles.

Exercise 4. — Breathing: Breathing exercises by protruding abdomen while the feet are on the bed, knees flexed and hands near the head, then placing the hands on the abdomen and elevating the thorax.

Exercise 5. — Back: With the patient in prone position and arms at the sides, the head and shoulders are elevated and then the lower extremities are hyperextended alternately.

Exercise 6. — Upper Extremities: (1) Clenching of fist and flexion and extension of elbow along the trunk; (2) flexion and extension of fingers rhythmically with elbows flexed at 90 degrees and arms abducted; (3) flexion and extension of neck and hand on occiput, and then on forehead; (4) rotation of neck with hands on occiput.

Exercise 7. — Progressive relaxation beginning with the feet, and then progressively to legs, trunk, chest, hands, arms, neck and face.[4]

The usual precautions must be observed in carrying out so varied a program of bed exercises. Pulse, temperature, respiration and overfatigue are especially watched. While responsibility for the procedure rests upon the nurse supervisor, the student and helper can conduct the activity after the first routine. So far, physician cooperation has been excellent, and the patient is always willing to cooperate. Since most patients with such methods of exercise are able to work on leaving the hospital, they serve as the most satisfactory salesmen for early bed activity.

In the medical program, the usual diseases encountered in our hospital are arthritis, vascular diseases, peripheral and central nerve injuries and disease, orthopedic disturbances. All require some physical and occupational rehabilitative procedure for adjunct therapy. As an example we will discuss the procedures involved in arthritis. In the medical management, the routine removal of foci, the proper administration of drugs and the health-building chemical measures are observed. The physical measures of heat, massage and exercise are judiciously applied for the purpose of improving circulation, relaxing spastic muscles, aiding in mobilization of joints and preventing muscle atrophy. Heat may be applied by means of bakers, radiant heat lamps, short wave diathermy and therapeutic pools. The home management becomes very important in prolonging the therapeutic effects and, as mentioned by Krusen,[5] may consist of paraffin, bakers, lamps, steam cabinets and the like. The effect of heat on the articular processes and the body as a whole is both direct and indirect. Massage is utilized for its effect in stimulating circulation, stretching connective tissue, breaking up adhesions and preventing atrophy by both the effleurage and the petrissage movements. Exercises are provided to prevent immobilization of articular structures, correct body posture, strengthen weak muscles and improve expansion of the thorax. Occupational therapy must be suited to the patient's individual need and carefully adjusted to keep up with his progress. The position at work and the amount of graded resistance, force and repetition must be carefully planned and executed. The activity is adapted to give graded stretching, graded resistance and muscle reeducation where there is joint limitation, muscle weakness and incoordination.

The commonest nerve disturbances encountered are the hemiplegias on a vascular or postoperative basis and poliomyelitis. Description of rehabilitation procedures in each would make a volume in itself; however, the hemiplegias are a very important group of neurologic conditions that receive little or no care. When the patient is hospitalized during the acute incident, provisions are made to prevent overextension of weak muscles; pillows or sandbags are placed at the feet, cock-up splints are used for the hands and passive motion in bed is used to prevent decubitus ulcers, pneumonia and the like. The early passive and active motion of the paralyzed extremities is done by the nurse and the technician. As the acute condition subsides, muscle reeducation is carried out by the physical and occupational therapy technicians. Functional occupational therapy is used early. Training in coordination is given with emphasis upon the demands of daily living, con-

4. Taylor, G. M.; McFarland, J. W., and Bond, Anna: Exercises for Convalescent Bed Patients, Arch. Phys. Med. 27:82 (Feb.) 1946.

5. Krusen, F. H.: Physical Medicine: The Employment of Physical Agents for Diagnosis and Therapy, Philadelphia, W. B. Saunders Company, 1941.

sisting of such procedures as turning a knob, opening a door, dressing, pulling a light cord, going to the toilet and shaving. When the patient is discharged from the hospital, home routines are demonstrated to the family. Further efforts for rehabilitation are carried out on an outpatient basis or by a visiting physical therapist in the home. Sheltered workshop routine provides a means of interesting the patient in proper coordinated movements and helps prepare for adjustment in future work efforts. The management of poliomyelitis is extensive and detailed, and requires special facilities in the acute stages.

In the subacute and chronic stages, the diligent application of physical therapy procedures is necessary to prevent incoordination of movement and increase power and endurance of muscles. The extensive hydrotheraphy plants associated with many public-financed institutions is a prohibitive financial burden which cannot be undertaken by the average hospital. To obviate this difficulty, a simple system has been developed to bring the weakened muscles back to normal or near normal power and endurance. Since the average patient has about two years of conservative therapy before operation or cessation of treatment, this therapy can be carried out both in the outpatient department and at home by improvised equipment. It involves the best principles of pulley exercises[6] and heavy resistance-low repetitive exercises.[7] In fact, this application of physical measures was made independently by Shroeder.[8]

In the high resistive-low repetitive exercise system, DeLorme has devised a special method for the restoration of muscle power. The low repetitive-high resistive exercise produces power, whereas the high repetitive-low resistive exercise produces endurance. Weakened and atrophied muscles should not be subjected to endurance-building exercises until the muscle power has been restored to normal by power-building exercises. In order to obtain rapid hypertropy, the muscle should be subjected to strenuous exercise to the point of maximum exertion. When the degree of muscle power is below a specific degree (such as fair), the DeLorme system is reversed, permitting its adaptation to paralyzed muscles even below the grade of fair. In this manner power can first be built into a paralyzed muscle and followed with endurance exercises. This is exceedingly important because most trends in exercise in the past have subjected the muscles weakened by poliomyelitis to endurance exercises before normal muscle power has been developed in them.

In this system, which is actually active assistive exercise that is gradually reduced to active resistive exercise, application can be made to muscles which are fair and poor in routine muscle testing. In other words, when muscles are exercised with gravity eliminated (the real purpose of using underwater exercise) or when assisted manually by the operator, there is no accurate way of measuring the amount of assistance required. Therefore, by using the same weights, but suspended over pulleys, the extremity can be assisted in its exercise effort. In an actual experiment by Shroeder, it was found if one starts with 10 pounds of assistance, the weights can be gradually decreased, until they reach zero (the range of active assistive exercise). At this point, with the muscle able to perform against gravity, the regular system is instituted, whereby the weights are then applied without the pulley apparatus and gradually increased as before to a point where the gain is stationary or where it equals the weight resisted by the corre-

6. Deaver, G. B., and Peterson, J. K.: Pulley Exercises to Increase Joint Movement, Arch. Phys. Med. 27:17 (Jan.) 1946.
7. DeLorme, T. L.: Heavy Resistance Exercises, Arch. Phys. Med. 27:607, (Oct.) 1946.
8. Schroeder, Alma: A Survey and Evaluation of Various Methods of Muscle Reeducation in the Treatment of Poliomyelitis Victims, to be published.

sponding muscle. For every exercise used for specific muscle resistance, a corresponding assistive exercise can be designed on the weight-pulley theory. This system of assistive and resistive exercise is far superior to the isolated muscle action obtained by hydrotherapy or similar assisted methods. Experiments have shown that by this high resistive-low repetitive exercise system some thigh group muscles atrophied by the effects of paralysis have increased their muscle girth ¾ inch to 2 inches in only three months of intensive treatment. This mode of application is valuable not only in poliomyelitis but for all muscles which are minimal in their muscle power. Also to be considered are the saving in space and money by eliminating expensive hydrotherapy setups and replacing them with simple inexpensive apparatus which can be used in the average hospital, and by slight revision in the home under supervision.

Many other conditions are presented to the department of physical medicine for treatment and rehabilitation. Recent literature has been replete with the discussions of the management of patients with paraplegia, cerebral palsy or peripheral nerve injuries. Each condition in itself would require volumes to discuss. It is sufficient to say that the common sense application of good physical and occupational therapy lightens the load of suffering and disability for these patients.

Rusk has recently stated: "Utilizing the experience of the armed forces, civilian hospitals can be made into institutions of opportunity. Surveys have shown that the average patient in the hospital spends 10 per cent of his time in pain and 90 per cent in boredom. There is real need for dynamic hospital programs designed to aid the convalescent patient in his orientation back to normal living. . . . Five per cent of general surgical patients, 15 per cent of the medical patients and 85 per cent of the orthopedic patients were in need of rehabilitation. . . . Thousands of critically needed hospital beds could be made available, if rehabilitation and convalescent facilities were available."

Conclusion

A coordinated program of physical therapy and occupational therapy affords a means of early and rapid rehabilitation of medical and surgical patients in a general hospital. A properly selected technical staff, a program of coordination with other hospital services and education of the staff to the advantages of the program will fill the existing gap and make restorative medicine an accepted and necessary phase of rehabilitation.

Discussion

Dr. Herman L. Rudolph (Reading, Pa.): Dr. Newman and Miss Jewett have presented an excellent program for physical and occupational therapy and other phases of rehabilitation which might well serve as a guide for those interested in the general hospital of nonuniversity centers and smaller communities, where the bulk of medical care is still greatest and the need just as urgent. The problems of space, personnel, equipment, finances, disinterested physicians and unsympathetic hospital administrators are not entirely insurmountable, as evidenced by the rapidly mounting members of newly organized departments in the smaller hospitals. As Dr. Newman has pointed out, the demobilization of large numbers of physicians and other veterans familiar with the concepts of current trends in rehabilitation has brought hospital administration to the point where the problems can no longer be ignored.

In tracing the developments in rehabilitation during World War II, it becomes increasingly disconcerting to note the failure of many to refer to the lessons of World War I when the illustrious R. Tait MacKenzie, in the service of the Canadian Army, developed phases of physical medicine which were little different from those of the present. In his interesting book, "Reclaiming the Maimed," which I consider a "must" on the reading list of all interested in physical medicine, patients were graded accord-

ing to fitness, just as we did in the service; the establishment of corrective gymnastics, manual arts and trade instruction was remarkably duplicated during the past war and now in the postwar period. Incidentally, it was MacKenzie who first described the hand table which we now call the Kanavel table. I particularly invite your attention to the work of this pioneer because to him must go much of the credit for the ground work in our highly effective coordinated programs of physical medicine.

The experience of many of us in the service has demonstrated that the most effective program necessitates close liaison between the sections of physical and occupational therapy. Those hospitals fortunate enough to afford both facilities must have, above all things, a physiatrist who is cognizant of the problems of the occupational therapy section, the work of which is generally less familiar to physicians than that of the physical therapy section. The burden of maintaining proper liaison must rest with the physiatrist, who, if courteously aggressive, can substitute for the reputed apathy of the medical profession a general acceptance of the current concept of rehabilitation. I dare say that perhaps the most important point of the comprehensive program as presented in this paper is the necessity for judicious collaboration with other professional services of the hospital, social, industrial and other contacts.

It is of interest to note the essayists' direction of attention to a home program utilizing simple exercise routines with inexpensive apparatus. I believe it is a mistake to expect that therapy administered in the office or clinic can be the only means of affording proper help for our disabled. There is much that the patient can do at home, provided — and I emphasize the provision — that we take the time to outline and discuss the home program and provided that we can be assured of an interested, cooperative and intelligent effort on the part of the patient.

PROGRESS IN USE OF ULTRAVIOLET RADIATIONS *

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Progress and milestones have always been associated. What then could be more natural than to consider the milestones in the use of ultraviolet radiations when reviewing the progress made in its use?

The first milestone in ultraviolet progress was the discovery by Ritter, in 1804, that the rays could cause chemical action. They blackened silver chloride, a chemical reaction which is still extensively used today in ultraviolet photography. Subsequently a host of other chemical reactions have been found to proceed in ultraviolet radiations, and some, like vitamin D production, have come to have important commercial uses.

The production of ultraviolet erythema results from a chemical reaction by ultraviolet radiations on protein in the malpighian layer of the epidermis. One of the substances formed appears to be leukotaxine which causes edema, swelling and migration of leukocytes. Still another substance, which has not been isolated, exerts a dilating action which produces the erythema.

Ultraviolet erythema produces what is known as a counterirritation. The biologic effects of counterirritation are well recognized as a means for the production of local effects such as dilation of blood vessels and sensation of warmth and mild anesthesia. More general effects may be a rise in blood pressure and accentuation of heart beat and respiration.

Ultraviolet applications have been used frequently for the production of counterirritation effects. Recently, D. A. Jesse[1] at the Physical Therapy Institute of Rotterdam, Netherlands, has advocated application of this therapy for the treatment of arthritis, neuralgia, neuritis and bursitis. He

* Read at the Seminar on the Progress of Physical Medicine, New York Polyclinic Medical School and Hospital, Dec. 1, 1947.

1. Jesse, D. A.: Een oriëntеerend onderzoek naar de therapeutirsche waarde van het ultravioleterytheem, Nederl. Tijdschr. v. geneesk. 90:1927 (Dec.) 1946.

claims that his method of application is different from that previously employed and that for this reason his results are more satisfactory than have been previously reported.

He says that in the past two mistakes have, in general, been made: 1. The skin area irradiated was too large. 2. The degree of erythema produced was not accurately controlled. According to his experiences, when the skin area is too large the patient does not obtain the maximum degree of benefit because the counter-reaction is not sufficiently localized. He prefers to irradiate an area 5 by 8 cm. on an arm or shoulder and 12 by 15 cm. if a leg. Only one area is irradiated at a time. He asserts that the degree of erythema employed is very important. If the erythema is too weak, favorable results are not obtained. If the erythema is too strong, so that inflammation results, the therapeutic effect will be debilitation. He recommends a definite red erythema and emphasizes that prior to the start of the treatments the conditions for the irradiation must be established. It is well known that skin areas on the same patient vary greatly in their response to ultraviolet radiation. A person's response itself varies from day to day, being dependent upon diet, humidity and other physical factors. Individuals differ in their response to ultraviolet radiation. Hence, it is not possible to apply a rule-of-thumb irradiation technic. Each patient must be actually tested at the time just prior to treatment for erythema responses. Thus, if a treatment is to be applied to a right shoulder, the correct dosage of ultraviolet rays must be established by the irradiation of small test areas on the left shoulder. The day following the test exposure the correct degree of erythema may be selected, and the exposure conditions employed to produce this erythema may then be employed for the actual treatments. The correct degree of erythema is definitely red but not uncomfortable to touch. Dr. Jesse found that the most satisfactory erythemas were produced by the hot quartz mercury arc lamp.

He claims for results, first, an analgesic effect — the patient feels less acute pain, moves the part more easily and sleeps better — and, second, a therapeutic effect — circulation improves, and muscular control is better. He maintains that his method produces results which compare favorably with results obtained by the employment of other physical agents but that he obtains his results by means of the ultraviolet erythema more quickly.

Another milestone in ultraviolet progress has been the recognition of the phenomenon of photosensitization. In a photosensitization process, the radiation which causes the reaction does not act directly upon the actual reactants but, instead, acts upon some substance which is capable of passing along the energy of the radiation, or a sufficient portion of it, to the actual reactants. The existence of photosensitization was recognized in 1900, but it was Klein and Rosseland in Germany in 1921 who first clearly defined the phenomenon. A large number of substances have been observed to be photosensitive. Some have been successfully employed in processes for the manufacture of commercially useful products, such as insecticides, waterproofing materials and chewing gum.

It had been observed that crude coal tar could sensitize the skin to ultraviolet radiations and that it was generally characteristic of skin sensitizers that they must reach the malphigian layer of the epidermis to be effective. About twenty years ago dermatologists began to treat psoriasis by application of coal tar sensitizer and ultraviolet rays. In 1941 a group of leading dermatologists reported very favorably upon the results obtained by such treatments, and, in fact, indicated that ultraviolet and photosensitization were the preferred method for the treatment of psoriasis.

Recently Ervin Epstein,[2] of Oakland, Calif., has reported an additional means for sensitizing the psoriasis reaction. He appears to have combined with the external photosensitization a means of internally photosensitizing the reaction. He has done this by administering to the patient orally four doses of 5 grains each of sulfanilamide on the day prior to the ultraviolet irradiation.

In order to establish the effectiveness of his procedure, he divided patients, 58 in all, into five groups. These groups were treated by the following means. (1) roentgen rays; (2) ultraviolet rays produced by the hot quartz mercury vapor arc lamp; (3) ultraviolet rays plus crude coal tar; (4) ultraviolet rays plus sulfanilamide; (5) ultraviolet rays plus crude coal tar and sulfanilamide. Sulfanilamide alone had been found to be ineffective for the control of psoriasis.

Epstein has reported that the ultraviolet photosensitized coal tar treatment appears equally as effective as roentgen treatment for the control of psoriasis and recommends it as a safe substitute for roentgen ray treatments when the latter therapy is not applicable. He found that ultraviolet irradiation alone was comparatively ineffective, which is in agreement with generally accepted opinion. The administration of sulfanilamide orally prior to the irradiation by ultraviolet greatly accelerated the average improvement, and confirmed an earlier observation by I. Tulipan[3] that sulfanilamide could photosensitize the ultraviolet treatment of psoriasis. When combined with coal tar photosensitization, the average number of required treatments was reduced to between one-third and one-half those customarily required when either roentgen ray or ultraviolet photosensitized coal tar treatments were employed.

Further evidence that sulfanilamide may act as a photosensitizer has been provided by Harold Blum,[4] who has studied its action on the enhancement of ultraviolet skin erythema. When a solution of sulfanilamide was injected intradermally just prior to an ultraviolet irradiation, the skin area at the site of the injection developed a more marked erythema than did surrounding areas. When the injection of the sulfanilamide was delayed until immediately after the ultraviolet irradiation, there was observed no added effect. Blum considered that this indicated that the action of the sulfanilamide was associated with the ultraviolet rays rather than directly on the response of the blood vessels of the skin. The action spectrum for the sulfanilamide appeared to be similar to that for normal ultraviolet erythema production, since there was no observable erythema, even with sulfanilamide injections, if the ultraviolet rays were filtered through a glass which removed the portion of the spectrum normally effective in erythema production.

The sulfanilamide reaction is not an isolated example of photosensitization. Many drugs and dyestuffs are known to behave as photosensitizers but have not been tried in controlled experiments to establish whether they possess value as therapeutic agents. Without controls, it is always possible to attribute results to some other factors. Further investigation of photosensitization in therapeutics appears to be warranted.

Another milestone in ultraviolet progress has been the recognition of the phenomenon of fluorescence. Ultraviolet fluorescence results when radiation displaces electrons in phosphors, which are substances having elastic electrons. The ultraviolet radiation pulls electrons out of their normal or-

2. Epstein, Ervin: Photosensitization in the Treatment of Psoriasis, J. Invest. Dermat. 8:203 (April) 1947.
3. Tulipan, L.: Treatment of Psoriasis with Photosensitizing Agents, Arch. Dermat. & Syph. 43:99 (Jan.) 1941.
4. Blum, H. F.: Am. J. Physiol. 129:312, 1940.

bits. When these electrons spring back, light visible to the eye is produced.

The practical observance of fluorescence was made possible by Prof. R. W. Wood in 1903 by the construction of filters which transmitted the ultraviolet rays but excluded visible light. The exclusion of visible light permitted fluorescence at low intensities to be observed and studied. Ultraviolet fluorescence is very familiar today, especially in the form known as the fluorescent lamp, in which the exciting ultraviolet rays and the fluorescence are generated with the same tube, and the fluorescence is used for illumination.

Many substances fluoresce when exposed to ultraviolet rays. Because of this and differences in the color of the fluorescent light, it is frequently possible to use fluorescence to distinguish between substances which otherwise can be differentiated only by laborious analyses. Fluorescence is used in industry for control of quality of materials. It has come to render valuable assistance in medical diagnosis.

Fluorescence as a diagnostic aid has been indispensable during the recent epidemic of tinea capitis,[4a] ringworm of the scalp, which has infected children in some parts of the United States. The fungus of this infection appears as a brilliant greenish yellow fluorescence when viewed by filtered ultraviolet rays from the hot quartz mercury vapor arc lamp. The fluorescence is very characteristic and cannot be confused with the fluorescence of any other fungus or disease of the scalp. By means of fluorescence the presence of the fungus may be observed several days before any other manifestation of the infection may be detected. It has proved a highly reliable tool for screening quickly all children in epidemic areas, isolating those with infection and controlling the spread of the disease.

The possibility that fluorescence may be employed for the differentiation of normal from malignant tissues was reported many years ago. During the war Louis Herley[5] was at the Cancer Institute, Bethesda, Md., and reported that differences in the appearance of benign and malignant tumors of the breast were sufficient when viewed by fluorescence to enable him to make a diagnosis. He made a diagnosis in 200 cases of suspected breast cancer. A laboratory check found that he was in error in only one observation.

Dr. Herly is now at Columbia University, where he has continued his investigations of fluorescence as a means for cancer detection. He reported to the International Cancer Congress recently assembled at St. Louis that blood serum from normal animals viewed by filtered ultraviolet appeared turbid and fluorescent, whereas the blood from cancerous subjects was clear and failed to glow. Herly said that cancer produced by injection of carcinogens into animals may be detected after only twenty to forty hours by fluorescence, whereas by other means five or more days are required for detection. The test has not as yet been applied to human subjects.

Prof. George Moore,[6] University of Minnesota, has just reported briefly in a note to *Science* that malignant tumors of the brain may be reliably recognized by fluorescence if prior to the inspection the patients have been given an intravenous injection of 5 cc. of a 20 per cent solution of sodium fluorescein. The dyestuff appears to concentrate in the tumors if they are malignant but does not concentrate in benign tumors. When tumors con-

4a. Wilson, J. W., and Plunkett, O. A.: Tinea Capitis, A Program to Minimize Severity of Impending Epidemic, Ann. West. Med. & Surg. 2:93 (May) 1947; Schwartz, L.; Peck, S.; Botvinick, I.; Liebovitz, A., and Frasier, E.: Control of Ringworm of the Scalp Among School Children, J. A. M. A. 132:58 (Sept. 14) 1946.

5. Herly, Louis: Cancer Diagnosis by Fluorescence, Cancer Research 4:227, 1944; Mod. Med. 15: 86 (Oct.) 1947.

6. Moore, George E.: Fluorescein as an Agent in the Differentiation of Normal and Malignant Tissues, Science 106:130 (Aug.) 1947.

tain sufficient dyestuff they fluoresce with a vivid yellow color when irradiated by filtered ultraviolet rays. The color is readily observed and unmistakable. However, if the tumors are located more than several millimeters below the surface of the brain tissue, the limited penetration of the ultraviolet rays may prevent the fluorescence from occurring.

The evidence that ultraviolet radiation can kill bacteria and viruses continues to increase. Research at the Michael Reese Research Foundation[6a] on ultraviolet irradiation of human plasma to control homologous serum jaundice have indicated that the method is a practical, yet harmless and safe, procedure which will free plasma or serum from the hazard of transmitting infectious hepatitis. Karl Habel[7] and B. Sockrider, of the United States Public Health Service, have devised practical means for inactivating vaccines in bulk by means of ultraviolet radiations. They employed a continuously flowing thin film irradiated by ultraviolet radiations at 2537 and 1849 A from a fused quartz sterilization lamp. The continuous flow feature and the long life of the lamp recommended their procedure for commercial production of large volumes of vaccines.

St. Luke's Hospital in New York city has reported the results of their six year study of the effects of ultraviolet air disinfection upon the incidnce of respiratory infections in children. They used the percentage of children showing respiratory disease each day as the index. The indexes when plotted against time showed a marked downward trend in respiratory infections during the period when the ultraviolet tubes were used as compared with the period before the tubes were installed. It was found desirable to use the tubes both during summer months and during the winter. The investigators noted the interesting observation that there appeared to be an obvious decrease in the incidence of respiratory disease among the adult attendants, even though they did not live in the building and hence were in the sanitary air only during working hours.

Great progress is being made in the application of ultraviolet air sanitation for the preservation of foods. A considerable portion of food spoilage results from air-borne bacteria and mold spores. Both of these can be killed by ultraviolet rays. Unlike chemical preservatives, the employment of ultraviolet air disinfection does not contaminate the food products with substances which if eaten regularly introduce the danger that they may contribute to some unforeseen biologic disturbance in later life. The ultraviolet method is entirely safe. The air, and not the foods, is irradiated.

Ultraviolet air sanitation may also protect foods from spoilage during failures of refrigeration. For example, meats require low temperature storage. Normally, they will spoil rapidly if kept at room temperatures. Spoilage is usually inevitable if refrigeration equipment in warehouses fails during the warm days of summer. During a recent Labor Day week end, a failure occurred in a large Chicago warehouse. The loss of tons of meat would have resulted. In spite of temperatures of 75 F., no meat loss occurred. The warehouse was equipped with ultraviolet air sanitation. The unexpected result was attributed to this factor.

Patients and physicians may benefit from air sanitation. The Committee on Research and Standards of the American Public Health Association[8] has recognized the value of ultraviolet air disinfection as an adjunct to aseptic technic in the reduction or elimination of air-borne bacteria in operating

6a. Wolf, A. M.; Mason, J.; Fitzpatrick, W. J.; Schwartz, S. O., and Levinson, S. O.: Ultraviolet Irradiation of Human Plasma to Control Homologous Serum Jaundice, J. A. M. A. 135:476 (Oct.) 1947.

7. Habel, K., and Sockrider, B. T.: A Continuous Flow Method of Exposing Antigens to Ultraviolet Radiation, J. Immunol. 56:273 (July) 1947.

8. Committee on Research and Standards, American Public Health Association, The Present Status of the Control of Air-borne Infections, Am. J. Public Health 37:13 1947. Higgins, R. A., and Hyde, G. M.: Ultraviolet Air Disinfection, New York State J. Med. 47:707 (April) 1947.

rooms and in contagious disease and pediatric wards, where conditions have indicated a significant incidence or risk of cross infection to patients. There are indications that air sanitation may be of value in schools, barracks and physicians' waiting and treatment rooms. However, these applications will not be officially approved until more conclusive evidence is available.

Ultraviolet blood irradiation therapy by Prof. George Miley and his associates,[9] employing the Knott technic, is being investigated as a means for control of pyogenic infections. In this technic the patient's whole blood is irradiated and returned to the donor. The action of the ultraviolet rays upon the blood is definitely not bactericidal — that is, the destruction of the bacteria and virus in the blood does not result from the direct action of the rays upon the bacteria themselves. Some indirect action as yet unknown must occur in the blood as a result of the irradiation. In a recent communication, Miley and Christensen[10] have reported upon 45 consecutive and unselected cases of acute pyogenic infections and 74 cases of virus-like infections. They confirmed their original observation, published in 1942. They claim that not only sulfonamide-resistant infections have responded to this therapy but a high percentage of penicillin-resistant infections have also responded favorably. In addition, they found that toxemias due to various virus infections subside rapidly, an extremely important clinical advantage in dealing with rapidly fulminating and overwhelming infection.

It is not possible to classify this upltraviolet reaction because the mechanism is too little understood. It will probably not be understood until after the biochemists have isolated the products of the ultraviolet irradiation and physiologists have studied their behavior. Miley claims that these products provide (1) a rapid and efficient control of the bacterial infection, (2) an increase in efficiency of oxygen exchange mechanisms, (3) a detoxifying action, (4) profound effects on the autonomic nervous system and (5) a relief of asthmatic symptoms. Miley postulates that an adequate ultraviolet ray intake is of primary importance for the maintenance of normal health.

9. Miley, George: Present Status of Ultraviolet Blood Irradiation, Arch. Phys. Therapy 25:357 (June) 1944.
10. Miley, George, and Christensen, J.: Ultraviolet Blood Irradiation Therapy: Further Studies in Acute Infections, Am. J. Surg. 73:486 (April) 1947.

PRESENT STATUS OF FEVER THERAPY *

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I. Clinical Considerations

The therapeutic possibilities following the development of a technic for a controlled, sustained temperature elevation of the human body aroused the interest of the medical world. Within a period of seven years, this interest reached the point where it was responsible for the gathering of the medical representatives of sixteen countries at a fever conference which was held in 1937. Unlike fever produced by the injection of foreign protein and biologic materials, the temperature elevation caused by physical means could be definitely prescribed for both temperature and time. This was particularly important for the care of diseases caused by the gonococcus. The thermolability of this organism permitted its destruction at a temperature which its human host could tolerate, though the margin of safety was not wide. Here, for the first time, was the means for achieving a cure of gonorrhea, a widespread disease, even though its ravages be extensive within a given patient. However, the treatment was arduous, dangerous and expensive, and its application required a highly specialized technic.

The discovery of the sulfonamides offered a more satisfactory possibility for the eradication of the gonococcus. Occasionally these drugs failed to achieve a cure. In such instances it was found by Kendell[1] and his associates that a single ten hour session of artificial fever combined with adequate chemotherapy for an eighteen hour period prior to the fever treatment appeared to be the procedure of choice in the management of chemoresistant gonococcic infection. Other workers, such as Licht and Dick,[2] also found that the combination of fever and sulfonamide compounds was the most satisfactory method of curing drug-resistant gonorrhea. I observed, as did Kendell, that fever therapy alone could produce cures in these resistant cases.

Penicillin was found to be an even more potent drug for the killing of these organisms. Since its use became general, the number of drug-resistant gonorrheas has been greatly reduced. Franks[3] observed 4 patients whose gonococcic infection proved resistant to large doses of penicillin. Organisms isolated from these patients were shown to be penicillin resistant by in vitro studies. In all these cases there was response to combined sulfonamides, penicillin and fever treatment. Dunfield and Mandel[4] reported a failure rate of 5.2 per cent with penicillin alone in a series of 154 cases of uncomplicated gonorrhea.

The idea of combining drugs of proved therapeutic value with physically induced fever in the effort to increase the effectiveness of both agencies is a logical one. Whether the basis of these results is an increase of the intensity of a chemical reaction at a high temperature; the addition of a chem-

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* Read at the Seminar on the Progress of Physical Medicine, New York Polyclinic Medical School and Hospital, Dec. 1, 1947.

1. Kendell, H. W.; Rose, D. L., and Simpson, W. M.: Artificial Fever Versus Fever-Chemotherapy in Gonococcic Infections Resistant to Chemotherapy, Arch. Phys. Therapy 22:103 (Feb.) 1941.
2. Licht, S., and Dick, V.: Fever and Sulfadiazine Therapy in Resistant Gonorrhea, Arch. Phys. Therapy 25:207 (April) 1944.
3. Franks, A. G.: Successful Combined Treatment of Penicillin-Resistant Gonorrhea, Am. J. M. Sc. 211:553 (May) 1946.
4. Dunfield, V. M., and Mandel, A.: Penicillin — Rapidity of Its Effect in Treatment of Gonorrhea, New York State J. Med. 45:614 (March 15) 1945.

ical effect to the thermal and humoral changes produced by fever or more subtle alterations in the body defense mechanisms, the clinical results justify such a therapeutic combination. This has proved true for the care of several diseases, particularly of syphilis.

The activities of Treponema pallidum (unlike those of the gonococcus) can be observed readily in experimental animals. This has permitted evaluations of both fever and chemotherapy when applied to syphilis in rabbits. Boak, Carpenter and Warren[5] have made such observations and have found that experimental syphilis in rabbits can be cured by combining a subcurative dose of neoarsphenamine with subcurative fever. Best results were obtained when the drug was given immediately before the induction of fever rather than directly after its termination. Bessemans and Denoo[6] also found the combined treatment to be effective in experiments with rabbit syphilis, particularly in the care of the later stages of the disease. The results achieved in the treatment of early syphilis in human patients by artificial fever and chemotherapy confirm this experimental evidence.

Chargin, Leifer and Hyman employed a continuous intravenous drip for five days to administer massive doses of chemotherapeutic agents in the effort to achieve the sterilans magna effect which Ehrlich originally thought that he had found. A natural sequel to the results reported by these workers was the idea of combining large doses of Mapharsen (oxophenarsine hydrochloride) and bismuth with one session of fever. Kendell and his co-workers[7] found that this intensification of fever-chemotherapy increased the complications during and after treatment. They therefore concluded that a ten hour session of artificially induced fever at 106 F. combined with administration of 120 to 240 mg. of Mapharsen and 4 grains of bismuth subsalicylate in oil (150 mg. of elemental bismuth) was not to be recommended as a routine treatment of early syphilis. It was the experience of these workers that large doses of arsenicals which do not produce reactions when given alone may cause serious complications when administered with artificial fever therapy. While the immediate reactions to the arsenicals are minimized when these drugs are given concomitantly with fever, the delayed reactions may be increased, symptoms of toxicity becoming evident during the postfever period. It was also their experience that the cotoxicities are additive when water-soluble bismuth, in doses ordinarily readily tolerated, is added to the treatment of early syphilis with fever-chemotherapy.

It appears reasonable to expect that if therapeutic reactions are enhanced by the addition of fever to chemotherapy toxic effects will likewise be increased. This expectation was confirmed by the experimental work of Boak, Dorn and Carpenter,[8] who found that when Marpharsen was administered to rabbits prior to a three hour fever at 41.5 C. the minimum toxic dose was decreased approximately 50 per cent and the maximum lethal dose was likewise decreased. When Marpharsen was administered to rabbits concurrently with fever, a greater amount of the drug was present in the tissues than in tissues from animals given injections of the drug only. They could not state whether this finding was due to an increased absorption of the com-

5. Boak, R. A.; Carpenter, C. M., and Warren, S. L.: The Concurrent Treatment with Fever and Neoarsphenamine of Experimental Syphilis in Rabbits, Am. J. Syph., Gonor. & Ven. Dis. 26:282 (May) 1942.

6. Bessemans, A., and Denoo, A.: Physicopyrexia and the Biologic Healing of Early and Late Syphilis in the Rabbit, Arch. Phys. Med. 27:547 (Sept.) 1946.

7. Kendell, H. W.; Rose, D. L.; Miller, E., and Simpson, W.: Artificial Fever and Chemotherapy in Early Syphilis, Arch. Phys. Med. 26:76 (Feb.) 1945. Kendell, H. W.; Craig, R. M.; Schwemlein, G. X., and Aron, H. C. S.: Artificial Fever-Chemotherapy, Arch. Phys. Therapy 25:593 (Oct.) 1944.

8. Boak, R. A.; Dorn, F. L., and Carpenter, C. M.: The Effect of Fever on the Toxicity of Mapharsen in Rabbits, Am. J. Syph., Gonor. & Ven. Dis. 29:428 (July) 1945.

pound or to a delayed elimination. Boak and her co-workers[9] found that a single prolonged fever treatment of ten to fifteen hours at 41.0 to 41.5 C. resulted in the prompt resolution of the lesions in a series of 8 cases of primary and secondary syphilis. These lesions usually became dark field negative during the single period of actual treatment. In general, such patients showed as much improvement within two or three days after fever therapy as patients with similar lesions might display in two weeks of ordinary chemotherapy. No appreciable effect upon the quantitative Wasserman reaction was noted. While the febrile state (41.0 to 41.5 C.) destroyed large numbers of Treponema pallidum, enough survived in the cool parts of the body to cause relapses, as indicated by the fact that 4 out of 5 patients who did not receive subsequent chemotherapy developed mucocutaneous relapses within four months.

Since penicillin has become available, we have had the opportunity of combining this drug with fever therapy in the care of neurosyphilis. Our usual dosage is 50,000 Oxford units every four hours while the patient receives two fever sessions a week. It is our impression that this is a most effective combination at the present time. More patients and longer periods of observation will be necessary for conformation of this impression.

Knight and Schachat[10] had the opportunity of treating 35 patients with syphilitic ocular conditions with the usual ophthalmic measures plus antisyphilitic chemotherapy and fever. They reported that of 19 patients with syphilitic atrophy of the optic nerve, improvement resulted in 4 (21 per cent); clinical progression of symptoms was arrested in 7 (37 per cent), and in 6 (32 per cent) the disease either continued to progress or began to progress during the combined treatment. They declared that in the treatment of syphilitic choroiditis this method is valuable, particularly when the lesions are fresh. It was employed for 6 patients with the acute form and resulted in decided improvement in 4 (67 per cent). In the other 2 patients old quiescent lesions were present. The method was beneficial in the treatment of syphilitic interstitial keratitis and was most helpful in alleviating the severe pain and photophobia which are often associated with this condition.

For many years the medical staff at the Mount Sinai Hospital in New York city have been interested in the diagnosis and treatment of patients suffering from subacute bacterial endocarditis. Although Emanual Libman claimed that he had seen an occasional spontaneous recovery from this disease, no one else had made any similar observation. On the strength of the idea that fever therapy might enhance the effectiveness of the sulfonamides, I suggested that this combination be tried in the treatment of one of the ward patients at this hospital who showed all the classic stigmas of the disease.[11] To our amazement this patient made a complete recovery, the first one of all the hundreds of patients who had been observed in this institution. Only 2 other recoveries occurred in a series of 16 patients. Of the 3 survivors, 2 were infected with the Streptococcus viridans and one with Hemophilus influenzae. The subsequent treatment of this disease with large doses of penicillin gave more satisfactory results. Our experience with the combined sulfonamide-fever approach would indicate the advisability of adding fever in the care of those patients whose disease might be found resistant to penicillin alone. On the possibility that an optimum chemical concentration of sulfonamides and temperature elevation might prove most effective

9. Boak, R. A.; Carpenter, C. M.; Jones, N.; Kampmeier, R. H.; McCann, W. S.; Warren, S. L., and Williams, J. R., Jr.: The Inadequacy of a Single-Prolonged Fever for the Treatment of Early Acute Syphilis, Am. J. Syph., Gonor. & Ven. Dis. 26:291 (May) 1942

10. Knight, H. C., and Schachat, W. S.: Hyperpyrexia in Treatment of Ocular Conditions Due to Syphilis, Arch. Ophth. 35:271 (March) 1946.

11. Bierman, W., and Baehr, G.: The Use of Physically Induced Pyrexia and Chemotherapy, J. A. M. A. 116:292 (Jan. 25) 1941.

in the treatment of subacute bacterial endocarditis, Dr. Schwartzman and I conducted numerous in vitro studies upon the hemolytic streptococcus. We failed to discover any inhibitory parallelism with increased doses of drug and fever.[12]

The idea of employing a combined therapy was applied by Stone,[13] who used artificial fever and vitamins in the treatment of anterior poliomyelitis. Eleven patients with severe acute anterior poliomyelitis received thiamine hydrochloride intraspinally, intramuscularly, intravenously and by mouth before the administration of fever. Four to ten fever treatments were administered, the temperatures ranging from 103 to 105 F. Stone claimed that the result of this approach relieved the pain and spasm, improved the circulation of the effected extremities, prevented contractures and increased the strength of the involved muscles. The hospitalization time was greatly reduced in all cases. These claims should, of course, be corroborated by others.

Another form of combined therapy was that applied by Shoulders and his co-workers,[14] who treated far advanced malignant growths with both fever and roentgen ray therapy. The temperature of his patients was raised to 104 to 106 F. for from thirty to sixty minutes. The patients were then transferred to the roentgen therapy room while body heat was retained by wrappings. Shoulders stated that there had been symptomatic improvement in 65 per cent of this group (27 of the 42 patients), with unquestionable evidence of regression of the primary growth and of metastatic lesions. He felt that there had been sufficient basic experimental work performed on the use of fever and roentgen ray therapy to justify the careful use of these combined procedures in man. The most satisfactory results were obtained in the treatment of sarcoma.

It appears to be the consensus among those who employ fever therapy that physically induced elevation of systemic temperature has a place in the present day treatment of infectious arthritis. As Osborne and his collaborators[15] have pointed out, if vasodilatation is an important factor in the treatment of this disease by fever, there is no need to exceed temperatures of 103 to 104 F. Maximum changes in peripheral circulation occur at this temperature level, as determined by finger plethysmography. It has been our experience that the results achieved in the care of arthritis show considerable variation. Osborne's review of 27 patients suffering from chronic infectious arthritis showed that 22 per cent were markedly improved, 22 per cent moderately improved, 33 per cent slightly improved and 22 per cent unimproved. Even more favorable results were recently reported by Drewyer,[16] who combined short and mild fever sessions with small doses of gold.

An explanation for the variation in results achieved in the treatment of bronchial asthma is offered by Stoesser and Cook,[17] who investigated the possible relation between electrolyte balance and bronchial asthma from repeated observation on 12 patients. They concluded that artificial fever gives only transient benefit in asthmatic patients whose intake of sodium chloride is normal or high before and during treatment. Fever therapy yields striking improvement or complete remission in asthmatic patients on a continu-

12. Bierman, W.; Schwartzman, G., and Rosenberg, S. I.: The Effect of Chemotherapeutic Sulfa Drugs Upon Growth of α-Hemolyticus Streptococcus. J. Lab. & Clin. Med. 29:454 (May) 1944.
13. Stone, S.: Artificial Fever and Vitamin Therapy in Treatment of Anterior Poliomyelitis, Arch. Phys. Therapy 24:350 (June) 1943.
14. Shoulders, H. S.; Turner, E. L.; Scott, L. D., and Grant, W. J.: Effect of Combined Fever and X-Ray Therapy on Far Advanced Malignant Growths, Radiology 29:184 (Aug.) 1942.
15. Osborne, S. L.; Markson, D. E.; Driscoll, R. E., and Merriman, J. R.: The Treatment of Arthritis by Electropyrexia, Including Some Physiologic Studies During Fever Therapy, J. Lab. & Clin. Med. 27:1135 (June) 1942.
16. Drewyer, G. E.: Low Grade Fever Therapy as an Adjuvant in the Treatment of Certain Types of Arthritis, Arch. Phys. Med. 29:284 (May) 1948.
17. Stoesser, A. V., and Cook, M. M.: Possible Relation Between Electrolyte Balance and Bronchial Asthma, Am. J. Dis. Child. 60:1252 (Dec.) 1940.

ous special diet low in salt (at least below 200 mg. of sodium daily). Remission due to the low intake of salt plus artificial fever can be terminated promptly by adding as little as 1 to 2 Gm. of sodium chloride to the diet.

Other diseases, the treatment of which we and other investigators have found beneficially influenced by physically induced fever include brucellosis, Sydenham's chorea, scleredema and traumatic ocular infections.

II. Considerations of Technic

The degree of arterial saturation during fever therapy was followed by Craig and co-workers by means of an oximeter placed on the patient's ear. This permitted the determination that the use of oxygen by nasal catheter with a rate of flow of 5 to 8 liters per minute is a satisfactory and efficient method of preventing or correcting the lowered percentage of arterial oxygen saturation.

The question of sedation during fever therapy has always been a difficult one because morphine sulfate and its allied preparations exert a depressant action on the central nervous system. Search has been made for other preparations which might be used for this purpose. Simpson and his co-workers employed Pantopon. Dowdy and Hartman recommended the use of Sedormid. However, many cases of purpura hemorrhagica have been reported as produced by this drug. Hartman and Major warned against the use of barbiturates, especially sodium amytal. Because of these considerations, Heldt and his associates[18] employed injections of Demerol hydrochloride in an initial dose of 100 mg. intramuscularly. A second dose of 100 mg. of Demerol was given two to three hours after the first dose. Most patients did not require the third dose of 50 to 100 mg. after another two to three hours. These workers found demerol superior to other drugs from the standpoint of management, safety and comfort of the patient.

III. Physiologic Changes

The fate of the vitamins of the body when the temperature is elevated has received some attention. Craig and co-workers[19] observed no significant changes in the plasma ascorbic acid level when the body temperature of 58 patients had been elevated to 105.0, 105.5 and 106 F. (rectal) for three, six or eight hours by means of physically induced fever. When the patient's plasma ascorbic acid level was low prior to the administration of the fever, ascorbic acid was given by mouth. The elevated plasma level was maintained during and after the fever.

Aron and his associates[20] studied the plasma vitamin A and carotene levels in 92 patients whose temperatures were elevated to 105.5 or 106 F. by means of physically induced fever. This treatment caused a depression in the plasma vitamin A and carotene. The extent of the depression was directly related to the duration of the fever. At the termination of the fever, the plasma vitamin A was nearly at its lowest level. The plasma vitamin A level was restored spontaneously, usually by the second day after treatment. The plasma carotene level showed a pattern similar to that of the plasma vitamin A. These workers formed the opinion that the plasma vitamin A behavior is the first biochemical indicator which could serve as a measurement of the intensity of the action of physically induced fever upon the human organism.

18. Heldt, T. J.: Dallis, N. P., and O'Connell, W. J.: The Use of Demerol in Artificial Fever, Am. J. Psychiat. 101:789 (May) 1946.
19. Craig, R. M.; Schwemlein, G. X.; Kendell, H. W.; Farmer, C. J., and Aron, H. C. S.: Effect of Elevated Body Temperature on the Plasma Ascorbic Acid, Arch. Phys. Med. 27:603 (Oct.) 1946.
20. Aron, H. C. S.; Craig, R. M.; Farmer, C. J.; Kendell, H. W., and Schwemlein, G. S.: Effect of Elevated Body Temperature on Plasma Vitamin A and Carotene, Proc. Soc. Exper. Biol. & Med. 61:271 (March) 1946.

The loss of body fluids during physically induced fever, according to Gibson and Kopp, produces a decrease in the blood volume.[21] Osborne,[22] taking care to maintain the blood volume by administering an adequate quantity of fluid containing sodium chloride, determined the changes in specific gravity of the blood in 10 patients whose temperatures were elevated to 104 F. and maintained there for four hours. Once the temperature plateau was reached, the patient's environmental temperature was usually maintained below or at the level of the rectal temperature. This is most important in minimizing water loss from the body. Thirty determinations of the specific gravity and forty observations of the percentage change of blood solids made before, during and after fever showed no significant changes in the specific gravity of the blood.

Observation of the sedimentation rates before, during, immediately after and the day after fever treatment were made by Fetter and Schnabel.[23] They found no significant variations in the sedimentation rate and therefore considered that an accurate determination of this rate could be made at any time during or after a fever session. In our own work we found that when the sedimentation rate was high in a disease which can be favorably influenced by fever therapy — as, for example, gonorrheal arthritis — the rate would fall during the days following the treatment.

Several years ago Dr. Fishberg and I and others observed the total disappearance of hydrochloric acid from the stomach during fever. More recently it occurred to Bandes, Hollander and me that this alteration might be of some value in the treatment of conditions characterized by gastric hyperacidity.[24] We accordingly made a detailed study of the effect of pyrexia on gastric acidity. From this we concluded that, while anacidity could be produced by this means, the fleeting character of this phenomenon did not warrant its employment in the therapy of peptic ulcer, particularly in view of the fact that the treatment itself is not a simple one.

Osborne and his co-workers noted the effect of hyperpyrexia on the secretion and flow of bile.[25] They found that a choleretic effect was produced in anesthetized biliary fistula dogs as a result of hyperpyrexia but not in dogs similarly prepared which were not anesthetized. They observed no significant effect of hyperpyrexia on the output of the various constituents of bile.

The liver glycogen is depleted during artificial fever, according to Loseke and Gunderson.[26] This effect is explained as a direct result of the elevation of blood sugar. While the blood sugar rises during artificial fever, the non-sugar reducing substance showed no consistent change.

The influence of fever upon the reproductive functions has naturally received the attention of workers in this field of therapy. Moore, Fukin and Young, experimenting with animals, found that degeneration occurs in the germinal epithelium, with consequent failure of spermatogenesis. Young showed that the mature sperm in the epididymis are very resistant to heat injury. This is confirmed by Macleod and Hotchkiss, who did not observe any marked changes in the mobility or morphology of the spermatozoa after

21. Gibson, J. G., and Kopp, I.: Studies in the Physiology of Artificial Fever: Changes in Blood Volume and Water Balance, J. Clin. Investigation **17**:219 (May) 1938.

22. Osborne, S. L.: Hyperpyrexia and the Specific Gravity of Blood, Arch. Phys. Therapy **22**: 407 (July) 1941.

23. Fetter, B., and Schnabel, T. R.: The Behavior of the Blood Sedimentation Rate During and After Fever Therapy, Am. J. M. Sc. **201**:115 (Jan.) 1941.

24. Bandes, J.; Hollander, F., and Bierman, W.: The Effect of Physically Induced Pyrexia on Gastric Acidity, Gastroenterology, to be published.

25. Osborne, S. L.; Grodnis, F. S.; Goldman, L., and Ivy, A. C.: The Effect of Hyperpyrexia on the Secretion and Flow of Bile, Am. J. Physiol. **132**:31 (Feb.) 1941.

26. Loeske, L., and Gunderson, M. F.: The Effect of Artificial Fever Upon Liver Glycogen, Arch. Phys. Therapy **22**:171 (March) 1941.

hyperpyrexia was applied to human subjects.[27] Although the elevation of body temperature in man in conjunction with simultaneous elevation of the environmental temperature results in the marked drop in spermatozoa production, the effects of hyperpyrexia upon spermatogenesis do not become apparent for nearly three weeks and may last for a period of fifty days thereafter.

As to the effect on the female, Cameron noted the contraceptive influence of artificial fever in rabbits.[28] His data indicated that during the first half of the twelve hour period between insemination and fertilization in the rabbit, one or both gametes can be fatally injured by twenty minute exposure of the adult female to temperatures of 109 to 110 F. involving elevation of general body temperature of 5 or 6 degrees. During the second half of the same period like treatment had no observed effect, but another period of susceptibility to heat was experienced on the third day after mating.

Ellingson and Clark reported on the influence of artificial fever on mechanisms of resistance.[29] When severe fever, near 41.5 C., was induced in rabbits during immunization with sheep red blood cells, typhoid vaccines and egg albumin, the specific antibody responses were impaired in varying degrees. More moderate fever, near 40 C., induced in rabbits during immunization with sheep red blood cells had no influence on the resulting titers of circulating antibodies. In rabbits already actively immunized against Eberthella typhosa, the introduction of high fever near 41.6 C. was followed by rapid reduction of antibody titers. Maintenance of fever for periods of eight hours daily on subsequent days held the titers at lower levels. In passively immunized rabbits, fever near 41 C. accelerated the decline of antibody titers. Complement content of serum of rabbits is either not affected or only slightly depressed during periods of fever. Severe fever induced during the early hours of intracutaneous infection of rabbits with type I pneumococci had no constant influence on the course of ensuing infection. Phagocytosis of staphylococci by guinea pig leukocytes in the presence of normal serum increased with rising temperature to a maximum at 40 C., showing a zone of normal activity from 39 to 41 C. Phagocytosis of staphylococci by leukocytes in human blood showed an optimal zone between 39 and 40 C.

Gottschall and associates investigated the effect of artificially induced fever on anaphylactic shock in actively sensitized guinea pigs.[30] They found that sensitivity to horse serum in mature serum-sensitive guinea pigs is suppressed by artificially induced fever temperatures of 109 to 110 F. when the serum is injected as soon as these temperatures are attained. Fever temperatures of 108 F. do not suppress anaphylactic shock if the injections of serum are made as soon as the animals reach this temperature, but if this temperature is maintained for thirty minutes a certain degree of protection is afforded. Serum-sensitive guinea pigs 112 weeks old are more readily protected than young guinea pigs (7 weeks old) when subjected to a fever temperature of 108 F. for thirty minutes.

The use of polarized light permitted Weaver to observe the histopathologic changes in myelinated nerve fibers following artificially induced hyperpyrexia.[31] Hyperpyrexia with temperatures between 108.7 and 109.1 F. and a duration of from four to seven hours resulted in marked degenerative

27. Macleod, J., and Hotchkiss, P. S.: The Effects of Hyperpyrexia Upon Spermatozoa Counts in Men, Endocrinology 28:780 (May) 1941.
28. Cameron, J. A.: Artificial Fever as a Contraceptive, Proc. Soc. Exper. Biol. & Med. 57:225 (Nov.) 1944.
29. Ellingson, H. V., and Clark, P. F.: The Influence of Artificial Fever on Mechanisms of Resistance, J. Immunol. 43:65 (Jan.) 1942.
30. Gottschall, R. Y.; DeKruif, P.; Cope, J. E.; Laurent, D.; Simpson, W. M.; Kendell, H. W., and Rose, D. L.: The Effect of Artificially Induced Fever on Anaphylactic Shock in Artificially Sensitized Guinea Pigs, J. Lab. & Clin. Med. 26:614 (June) 1944.
31. Weaver, H. M.: The Histopathologic Changes in Myelinated Nerve Fibers Observed by the Polarized Light Method Following Artificially Induced Hyperpyrexia, J. Lab. & Clin. Med. 26:1295 (May) 1941.

changes of irreversible and reversible types in the peripheral nerves of rabbits. In rabbits subjected to hyperpyrexia until death and in which the temperature did not exceed 108.3 F. the peripheral nerves were characterized by degenerative changes in the reversible type and, furthermore, the intensity of these changes was directly proportional to the height of the temperature. Weaver thought it quite possible that changes of this nature are responsible for the occasional occurrence of neuritis in patients following artificial fever therapy. In rabbits subjected to intermittent periods of hyperpyrexia, the peripheral nerves showed only mild intensities of the reversible type of degeneration. In rabbits subjected to hyperpyrexia with temperatures of 107.6 to 108 F. for eight hours and in which thirty days intervened between exposure and cancellation, the peripheral nerves showed changes with evidence of a rapid return to normal.

Summary

The development of antibotics has greatly reduced the necessity for the use of physically induced fever in the treatment of gonorrhea. Such fever still has a place in the treatment of drug-resistant infections. Combined with chemotherapy, it is valuable in the treatment of central nervous system syphilis, and by itself it is of value in the care of syphilitic infections of the eye. It is useful in the treatment of arthritis, brucellosis and Sydenham's chorea. It is claimed to be of value in the therapy of anterior poliomyelitis and malignant growths when combined with roentgen radiation. Demerol is said to be the best form of sedation during the administration of fever. Plasma vitamin A and carotene levels become depressed during the administration of physically induced fever. Elevation of body temperature has a delayed inhibitory influence upon spermatogenesis. In rabbits, fever causes a reduction of antibody titers and occasionally of the complement contained in the serum. It increases phagocytosis. It suppresses serum sensitivity in susceptible guinea pigs. Myelinated nerve fibers of the rabbit can be damaged by prelethal temperatures.

THE CONSTRUCTION, CALIBRATION AND USE OF THERMOCOUPLES FOR MEASURING BODY TEMPERATURE *

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The desirability of measuring the temperature of the body in various areas makes the thermocouple an instrument of necessity. Although there are numerous types of thermocouples available, the simplicity of construction, if proper procedures are followed, permits them to be made in almost any laboratory. Since the physical principles involved in thermocouple construction and operation are well defined, the problem consists in making use of these principles and adapting them to the problems at hand. Such an instrument has been described by Sheard[1] and others.

Experience in this laboratory in the construction and use of various types of thermocouples for measuring temperature in various parts of the body has resulted in the development of technics of construction which are simple and inexpensive and which provide an accurate instrument. To facilitate the use of laboratory thermocouples, the technics required for successful construction and use are described.

Principle of the Thermocouple

When two wires made of dissimilar elements are joined together, a difference of potential occurs. This difference in potential can be expressed in terms of temperature. In practice, it is always compared with the voltage generated by a second thermocouple which is in a medium of known temperature. The difference in voltage between the two thermocouples can be used to determine the difference in temperature between the two junctions. The junction which is in the medium of known temperature is designated as the reference junction. In reality, what is being done is the algebraic subtraction of the e.m.f. of the reference junction from the e.m.f generated by the thermocouple in the medium of unknown temperature.

Materials Required

There are several combinations of wire which may be used in the construction of thermocouples for measuring body temperature. In any event the wire employed must be well insulated so as to prevent contact except at the point of union. Since high grade insulated thermocouple wire is available, attempts to insulate bare wire are discouraged.

For measuring temperature anywhere in the body, a thermocouple made by the union of No. 30 (B and S gage) iron and No. 30 constantan wire is recommended. Although enameled wire is reasonably resistant to damage by handling, care must be exercised to avoid damage to the insulation.

* This study was aided by a grant from The Baruch Committee on Physical Medicine in New York city.

1. Sheard, C.: The Electromotive Thermometer, Am. J. Clin. Path. 1:209 (May) 1931.

Wire for connecting the thermocouple to the reference junction is also available. It is recommended that No. 22 stranded iron-constantan wire in a ¼ inch rubber-covered cable be used for this purpose where iron-constantan junctions are employed.

A No. 20 hypodermic needle is the smallest gage into which two strands of No. 30 insulated wire can be inserted. This size needle is satisfactory for measuring intramuscular and subcutaneous temperatures. A No. 13 needle is used for measuring rectal and oral temperatures.

Construction of the Thermocouple

In order that the union can be inserted either into a muscle or under the skin it is soldered into the point of a hypodermic needle. The base of the hypodermic needle is shaped so that it fits into a housing (holder) as shown in chart 1. The housing serves not only as support for handling the needle but also as a means for connecting the thermocouple wires to the cable leading to the reference junction. The housing and needle are fitted so that it is unnecessary to employ solder to insure a watertight joint (charts 1 and 2).

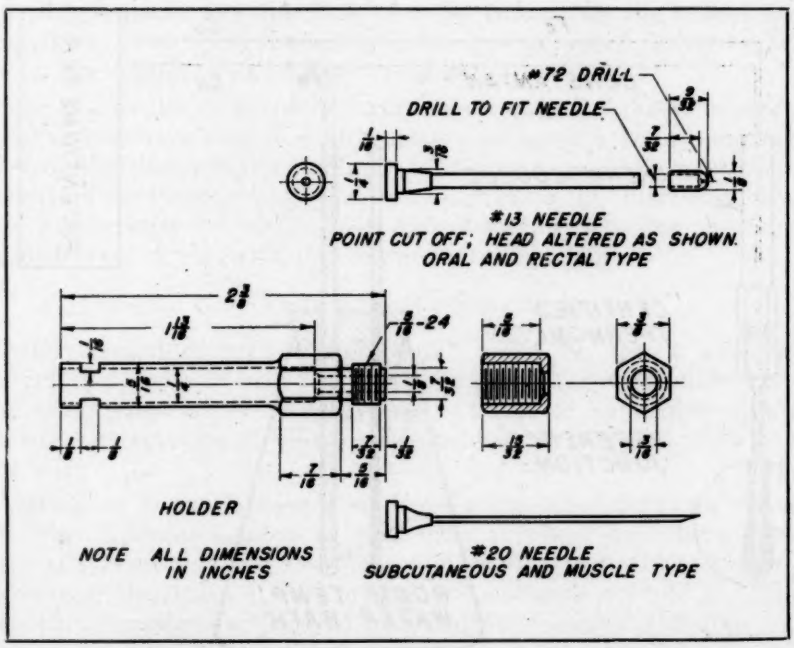

Chart 1. — Details of the parts used in the construction of hypodermic needle thermocouples.

The procedure in construction is as follows: A piece of enameled iron wire several centimeters longer than the needle employed is soldered to the strand of iron wire in the lead wire cable. (The iron can be separated from the constantan strand by a magnet since iron is magnetic and constantan is not.) Likewise, a piece of constantan wire is soldered to the constantan strand in the lead cable. Silver solder with a boric acid flux is used to unite the wires. A dental blowpipe adjusted to a pinpoint flame may be used for soldering. The bare iron and constantan unions are insulated from one another by narrow strips of friction tape. The next step is to insert the lead

cable into the housing far enough so that it can be secured by stout thread around the notch in the housing. Next, the thermocouple wires are fed through the needle. The needle is then secured to the housing by the nut as shown in charts 1 and 2. By tightening the nut the needle is made secure and the joint watertight. The thermocouple wires are pulled tight through the needle. At the bevel of the needle both the iron and the constantan wire are cleaned free of enamel by scraping them with the point of a scalpel. Care should be taken to remove the insulation as far back into the opening as possible. Then the wires are twisted together by not more than two turns. The wires are soldered together and to the point of the needle with silver solder. Care should be taken that sufficient solder flows into the opening around the junction to insure complete closing of the opening in the point of the needle and to insure good electrical contact between the wires, that will not be broken when the needle is first sharpened. The excess wire is cut off and the cutting edge of the needle reestablished by grinding on a fine stone.

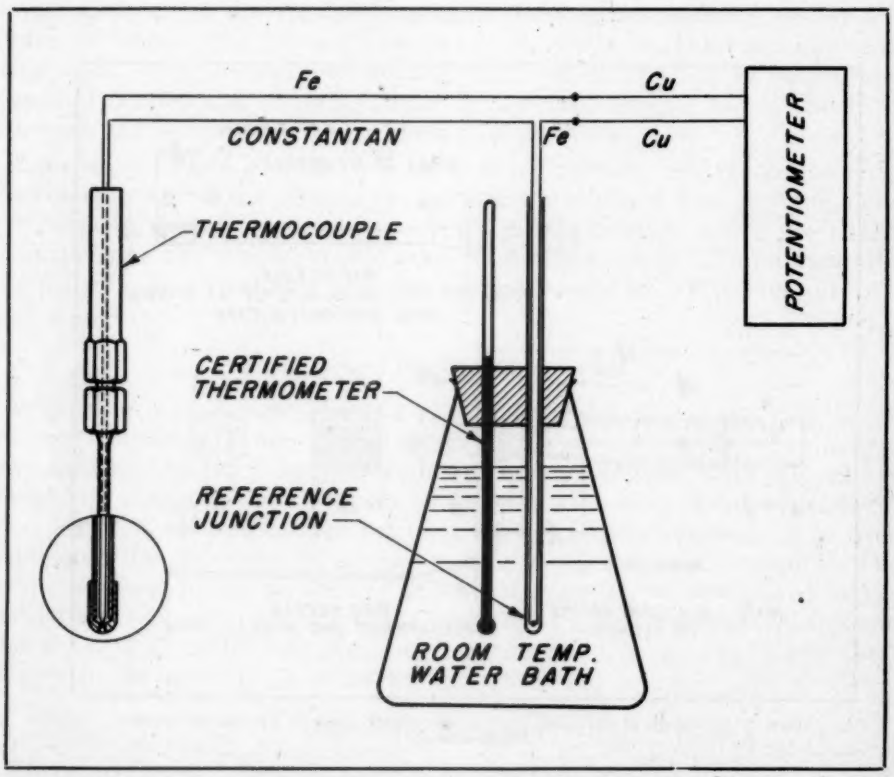

Chart 2. — Arrangement of thermocouple, reference junction and potentiometer.

For measuring rectal and oral temperature a large needle (No. 13) is employed. This requires some modification at the tip so as to facilitate the soldering of the union. The procedure is to cut off the point of the needle and fit a small brass cap over it (chart 1). The union is soldered into the hole in the cap, and the cap is soldered over the end of the needle, both in one operation. Otherwise the construction procedure is the same as previously described.

The Reference Junction

The consideration given the reference junction depends on the type of potentiometer available for measuring voltage. Potentiometers are available equipped with an automatic reference junction compensator which eliminates all compensation and constant temperature devices. If the potentiometer employed requires manual compensation for reference junction e.m.f., as is usually the case, the most convenient reference medium is a flask of water kept at room temperature equipped with a certified thermometer graduated in tenths of a degree centigrade. The arrangement of the reference junction is shown in chart 2. It consists of an iron-constantan union inserted into a glass tube with one end closed. The glass tube containing the thermocouple is immersed in the water bath beside the thermometer. The reference junction and the thermocouple are connected to the potentiometer by copper wires soldered to the iron lead wires as shown in chart 2.

The reference junction assembly must be kept either where the temperature is constant or where the changes are small and occur slowly. Otherwise, heat conduction along the wire and thermal gradients between the union and the bulb of the thermometer may introduce errors in the measurement. This requires that the flask of water containing the reference junction be kept away from such disturbing influences as heated radiators, laboratory burners, open windows and direct sunlight.

The use of the room temperature water bath for the reference junction has the convenience that it is unnecessary to apply a stem temperature correction to the thermometer reading. The accuracy of the reference junction temperature measurement can be checked easily by inserting the thermocouple needle into the water bath and observing whether the temperature thus measured agrees with the thermometer reading.

Testing the Thermocouple

After assembly, each thermocouple must be tested and calibrated. Different specimens of iron and constantan wire may give different voltages at the same temperature. This is due to traces of impurities which are too small to be detected by chemical means and to the physical state and history of the wire.

Variations in thermocouple readings when more than one thermocouple made from different batches of wire were involved have been reported by Roeser and Wensel.[2] On the basis of the data presented, one can expect variations of the order of 0.04 mv. at temperatures near 37 C. This corresponds to a variation in observed temperature of almost 1 degree.

It is not difficult simultaneously to test and calibrate a thermocouple, and thus to establish a table for it, within the physiologic range. The procedure is as follows: Set the reference junction compensator of the potentiometer for the e.m.f. corresponding to the reference junction temperature, as listed in a standard reference table (the table). This will give point *A*, chart 3. Place a certified thermometer and the thermocouple needle in a beaker of stirred warm water (e. g., 40 C.), balance the potentiometer, record the reading and read the thermometer. This gives point *B*, chart 3. To get point *C*, repeat with a beaker of less warm water (e. g., 30 C.). To get point *D*, repeat with a beaker of cool water (e. g. 10 C.). Connect *DA*, *AC* and *CB* with straight lines. If desired, even more points may be used. If the graph is

2. Roeser, H. C., and Wensel, H. F.: Methods of Testing Thermocouples and Thermocouple Materials; U. S. Bureau of Standards Journal of Research, 14:247 (March) 1935. Also, Temperature, Its Measurement and Control, Reinhold Publishing Company, p. 305.

drawn on a sufficiently large scale, values of the e.m.f. corresponding to each 0.1 degree may be read off and tabulated for easy reference.

This table is then substituted for the standard reference table. If the points *A, B, C* and *D* are carefully and correctly determined, an accuracy of ±0.1 degree C. should be obtained.

In use of a thermocouple, if the needle is not inserted well into the tissue or sufficiently far under the skin, there may be a sufficient conduction of heat along the needle toward the handle, which is at room temperature, that the junction does not register exactly the temperature of the surrounding tissue. Bazett and McGlone[3] have investigated the error thus introduced. They found that when the needle was inserted 10 mm. or more the error was negligible.

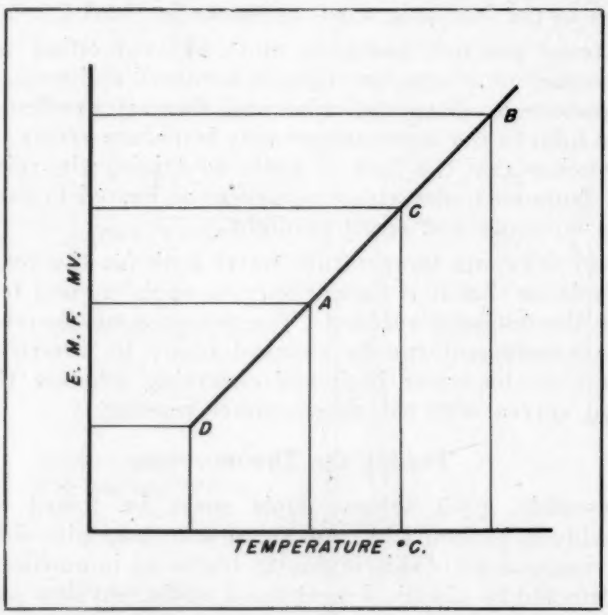

Chart 3. — Illustration of method of calibrating a thermocouple.

One must also consider the limitations of the potentiometer which is used to measure thermocouple voltage. In this laboratory a Leeds and Northrup type 8662 potentiometer is employed. This instrument can be read to 0.005 mv., which corresponds to about 0.1 degree C. Any error encountered in many thermocouples constructed as described falls within the error introduced by the limitations of the potentiometer used. If the limitation in the potentiometer is ±0.1 degree and the limitation in the calibration and use of the thermocouple is ±0.1 degree, measurements accurate to ±0.2 degree can be made.

Experience in this laboratory has shown that thermocouples constructed with the use of enameled iron and constantan wire and arranged as described give consistent results when used with a standard table without special calibration. This table is made to agree with the Leeds and Northrup Conversion Tables at the temperatures which are given in the latter. For comparison of results obtained with different thermocouples in different laboratories, or

3. Bazett, H. C., and McGlone, B.: A Portable Thermoelectric Apparatus for the Determination of Surface and Tissue Temperatures, J. Lab. & Clin. Med. 12:913 (June) 1927; Temperature Gradients in the Tissues in Man, Am. J. Physiol. 82:415 (Oct.) 1927.

even with thermocouples in the same laboratory which are made from different batches of iron and constantan wire, however, the thermocouples should be calibrated against certified thermometers. This calibration is necessary to give accurate measurements of the temperature itself, as contrasted with measurements of small differences in temperature.

Conversion Table for Iron-Constantan Thermocouples

Degrees C	0	.1	.2	.3	.4	.5	.6	.7	.8	.9
20	1.040	.045	.050	.056	.061	.066	.071	.076	.082	.087
21	1.092	.097	.102	.108	.113	.118	.123	.128	.134	.139
22	1.144	.149	.154	.160	.165	.170	.175	.180	.186	.191
23	1.196	.201	.206	.212	.217	.222	.227	.232	.238	.243
24	1.248	.253	.258	.264	.269	.274	.279	.284	.290	.295
25	1.300	.305	.310	.316	.321	.326	.331	.336	.342	.347
26	1.352	.357	.362	.368	.373	.378	.383	.388	.394	.399
27	1.404	.409	.414	.420	.425	.430	.435	.440	.446	.451
28	1.456	.461	.466	.472	.477	.482	.487	.492	.498	.503
29	1.508	.513	.518	.524	.529	.534	.539	.544	.550	.555
30	1.560	.565	.570	.576	.581	.586	.591	.596	.602	.607
31	1.612	.617	.622	.628	.633	.638	.643	.648	.654	.659
32	1.664	.669	.674	.680	.685	.690	.695	.700	.706	.711
33	1.716	.721	.726	.732	.737	.742	.747	.752	.758	.763
34	1.768	.773	.778	.784	.789	.794	.799	.804	.810	.815
35	1.820	.825	.830	.836	.841	.846	.851	.856	.862	.867
36	1.872	.877	.882	.888	.893	.898	.903	.908	.914	.919
37	1.924	.929	.934	.940	.945	.950	.955	.960	.966	.971
38	1.976	.981	.986	.992	.997	.002	.007	.012	.018	.023
39	2.028	.033	.038	.044	.049	.054	.059	.064	.070	.075
40	2.080	.085	.090	.096	.101	.106	.111	.116	.122	.127
41	2.132	.137	.142	.148	.153	.158	.163	.168	.174	.179
42	2.184	.189	.194	.200	.205	.210	.215	.220	.226	.231
43	2.236	.241	.246	.252	.257	.262	.267	.272	.278	.283
44	2.288	.293	.298	.304	.309	.314	.319	.324	.330	.335
45	2.340	.345	.350	.356	.361	.366	.371	.376	.382	.387

Summary and Conclusions

A method of construction, calibration and use of an accurate, inexpensive thermocouple for measuring temperature in various parts of the body is described.

With the most commonly used potentiometers, the accuracy with which measurements can be made is determined by how closely the potentiometer employed can be balanced.

COMMITTEE REPORTS
AMERICAN CONGRESS OF PHYSICAL MEDICINE

Report of the Finance Committee

The report of our auditor which follows indicates that for the year ending December 31, 1947 the American Congress of Physical Medicine continued to operate on a sound financial basis.

The officers of the Congress are to be congratulated on the wise expenditures of our funds and the stable condition of our finances.

Frank H. Krusen, M.D., Chairman.
Frank H. Ewerhardt, M.D.
Roy W. Fouts, M.D.

Report on Examination for Year Ended December 31, 1947

March 29, 1948.

American Congress of Physical Medicine,
30 North Michigan Avenue,
Chicago, Illinois.

Dear Sirs:

We have examined the balance sheet of the American Congress of Physical Medicine as of December 31, 1947, and the summary of net income and surplus for the year ended that date, have reviewed the accounting procedures of the Congress and, without making a detailed audit of the transactions, have examined or tested accounting records of the Congress and other supporting evidence by methods and to the extent we deemed appropriate, except as stated in the following paragraph.

We did not verify the income from subscriptions to "Archives", a magazine published monthly by the Congress, because it was not considered practicable. However, we tested the correctness of the subscription income recorded on the books by reference to available supporting details.

Based on our examination, limited to exclude verification of "Archives" subscription income, in our opinion, the accompanying balance sheet and summary of net income and surplus fairly present, in conformity with generally accepted accounting principles applied on a basis consistent with that of the preceding year, the financial position of the American Congress of Physical Medicine at December 31, 1947, and the results of its operations for the year ended that date.

We submit the following exhibits and schedules:
Exhibit —

A — Balance Sheet, December 31, 1947.
B — Summary of Net Income and Surplus for the Year Ended December 31, 1947.

Yours truly,
George Rossetter & Co.

Exhibit A

American Congress of Physical Medicine
(Incorporated in Illinois — Not for Profit)
Balance Sheet, December 31, 1947

Assets

Current Assets:		
Cash in bank and on hand		$ 3,338.87
Accounts receivable:		
Advertisers and exhibitors	$ 1,218.75	
Members' dues	308.50	
American Registry of Physical Therapy Technicians	1,340.04	
American Board of Physical Medicine	191.48	
American Society of Physical Medicine	57.84	
Total	$ 3,116.61	
Less reserve for doubtful accounts	200.00	2,916.61
Investments in United States Savings bonds, Series G — at cost		20,000.00
Accrued interest		166.66
Deposit at United States Post Office		50.00
Total		$26,472.14

Liabilities

Current Liabilities:		
Accounts payable — New York Society of Physical Medicine		$ 5.00
Employees' income tax withheld		426.20
Deposits		10.59
Total current liabilities		$ 441.79
Deferred Income:		
Subscriptions to "Archives" unexpired portion	$ 6,263.85	
Dues collected in advance — year 1948	610.50	
Total deferred income		6,874.35
Surplus, per Exhibit B		19,156.00
Total		$26,472.14

Exhibit B

American Congress of Physical Medicine
Summary of Net Income and Surplus for the Year Ended December 31, 1947

(*Continued on page 425*)

ARCHIVES of PHYSICAL MEDICINE

OFFICIAL PUBLICATION AMERICAN CONGRESS OF PHYSICAL MEDICINE

∴ EDITORIALS ∴

ANNUAL MEETING, 1948, WASHINGTON, D. C.

The twenty-sixth annual meeting of the American Congress of Physical Medicine will be held September 7 through 11 at the Hotel Statler in Washington, D. C. The program is printed in this issue of the ARCHIVES.

On Wednesday, Thursday and Friday two morning sessions will be given —a general scientific section and a section sponsored by the American Society of Physical Medicine. The sections sponsored by the American Society of Physical Medicine will consist of reports of recent basic research in physical medicine. Noteworthy contributions will be presented including the effects of various physical agents on the vascular system such as short wave and microwave diathermy, iontophoresis, sinusoidal stimulation and induced fever; electromyography; experimental muscular spasticity; studies on muscle response to potassium, fatigue, etc., and others. These papers will appeal to physicians interested in the latest developments and scientific advancements in the field of physical medicine.

The papers for the general scientific session in the morning will be more general in nature and include such important subjects as the care of the aged; treatment of disabilities of the shoulder; effect of physical agents on intra-articular temperature; massage and circulation; brachial neuralgia and numerous others.

In the afternoon, one general scientific session will be held. The papers will appeal to physiatrists whether in research or clinical work, all physicians, physical therapists, occupational therapists and everyone interested in the progress and clinical application of physical medicine. Many of the subjects will be of a pratcical nature; others will demonstrate the recent advances, whereas two papers will tell of activities which are closely associated to this special field. On Wednesday afternoon, the Congress will be honored by the presence of Dr. Basil Kiernander of England who will present his paper "Recent Advances in Physical Therapy in the United Kingdom."

This year two separate groups of instruction courses will be given. One course of ten lectures will be reserved for physicians. The lectures of this course will be devoted to the principles and physiology as they pertain to physical medicine. The lectures should interest physiatrists, candidates preparing for the Board of Physical Medicine and physicians who wish to be instructed in the more advanced phases of physical medicine. The other course of ten lectures will consist of more general and clinical subjects. Physicians and physical therapists who are registered with the American Registry of Physical Therapy Technicians will be permitted to register. The list of instructors for this course include Doctor Mennell of London, England who will demonstrate his methods of manipulation; Doctor Phelps who will devote two hours in the discussion of the management and treatment of patients with cerebral palsy; Doctor Kelly on arthritis; Doctor Knapp will give many

practical suggestions in the treatment of fractures; Doctor Kottke on shoulder disorders, Doctor Licht on occupational therapy and Doctor Wise on muscle strengthening exercises.

The annual banquet will be on Thursday evening. This event is always one of the notable affairs of the meeting. For this year something different is promised.

The city of Washington has everything to offer as a place for a visit. For the members of the Congress the unusual scientific programs this year at the Hotel Statler will compete with the allurements of the city itself but for the wives who accompany their husbands, our national capitol is ideal. The innumerable public buildings and historic monuments, endless parks and beautiful museums and numerous other attractions will satisfy everyone. Washington, too, justifiably boasts of its fine stores and shops, restaurants, theaters, and other places of amusement.

The 1948 meeting should be memorable.

PHYSICAL MEDICINE ***

The following services are approved by the Council and the American Board of Physical Medicine

Hospitals, 34; Assistant Residencies and Residencies, 70

Name of Hospital	Location	Chief of Service	Patients Treated	Number of Treatments	Asst. Res. and Residencies Offered[3]	Beginning of Service (1948)	Length of of Service Offered (Years)	Beginning Stipend (Month)
United States Army								
†Letterman General Hospital★	San Francisco	A. V. Bateman	5,994	285,400	2	1/1	1–3	"
†Fitzsimons General Hospital★	Denver	J. H. Kuitert	2,506	119,005	2	1/1	1–3	"
Walter Reed General Hospital★	Washington, D. C.	E. M. Smith	8,573	238,036	3	1/1	1–3	"
†Percy Jones General Hospital★	Battle Creek, Mich.	A. E. White	28,849	346,505	2	.....	1–3	"
Veterans Administration								
Veterans Admin. Hospital	Chamblee, Ga.	W. Steiner	.....	20,400	1	7/1	1+	$275.00
†Veterans Admin. Hospital	Hines, Ill.	L. Newman	37,369	482,960	7	.....	1–3	275.00
Veterans Admin. Hospital	Framingham, Mass.	F. Friedland	10,130	194,794	2	7/1	1–2	275.00
†Veterans Admin. Hospital	Jefferson Barracks, Mo.	F. Ewerhardt	2,589	71,974	2	7/1	1+	275.00
†Veterans Admin. Hospital	New York City	H. Kessler	21,729	287,884	3	1/1, 7/1	1–3	275.00
†Veterans Admin. Hospital	Portland, Ore.	E. W. Fowlks	3,230	65,750	1	7/1	1–3	275.00
Nonfederal								
†Los Angeles County Hospital★[4]	Los Angeles	O. Huddleston	.....	14,633	2	Varies	2	.....
†White Memorial Hospital★	Los Angeles	F. B. Moor	500*b*	20,000*b*	1	7/1	1–3	147.33
Stanford University Hospital★[4]	San Francisco	W. H. Northway	.....	6,561	2	7/1	1–2	50.00
†University of California Hospital★†	San Francisco	F. Baker	.....	7,123*b*	1	7/1	1	50.00
University Colorado Medical Center †Colorado General Hospital★[4]	Denver	H. Dinken	2,905	64,050	1	Varies	1–3	75.00
†Emory University Hospital★	Emory Univ., Ga.	R. L. Bennett	7,836	.....	1	.....	1–3	.....
†Georgia Warm Springs Foundation	Warm Springs, Ga.	R. L. Bennett	.....	84,000	1	.....	1–3	.....
Michael Reese Hospital★[4]	Chicago	C. O. Molander	1,534	16,282	2	7/1	1	25.00
Passavant Memorial Hospital★[4]	Chicago	J. S. Coulter	7,784*b*	12,696*b*	2*h*	.....	1	.....
University of Kansas Hospital★	Kansas City, Kan.	Donald L. Rose	2,775	25,347	3	.....	1½	.....
†Massachusetts General Hospital★	Boston	A. L. Watkins	1,639*b*	16,265*b*	2	.....	1–3	41.67
†University Hospitals★[4]	Minneapolis	M. Knapp	7,677	12,141	2	7/1	1–3	115.00
Mayo Foundation	Rochester, Minn.	F. H. Krusen	.....	**	6	.....	3	.....
†Bellevue Hospital, Div. III—N. Y. Univ.★	New York City	H. A. Rusk	.....	.....	7	Varies	1	70.00
†Goldwater Memorial Hospital★[4]	New York City	H. Behrend	872	53,738	1	.....	1	120.00
†Hospital for Joint Diseases★[4]	New York City	J. Weiss	78,386	91,746	2	1/1	1+	40.00
†Montifiore Hospital for Chronic Diseases★	New York City	K. Harpuder	.....	.....	1	.....	1+	50.00
†Mount Sinai Hospital★[4]	New York City	.....	7,310	9,920	1	1/1, 7/1	1	50.00
†Presbyterian Hospital★[4]	New York City	W. B. Snow	77,771	221,144	1	.....	1	41.66
St. Luke's Hospital★	New York City	R. Muller	2,123	104,604	1	Varies	1	50.00
†Cleveland Clinic Foundation Hospital	Cleveland	W. J. Zeiter	16,257	39,919	1	7/1	1–3	100.00
†Hospital of the Univ. of Pennsylvania★[4]	Philadelphia	G. M. Piersol	1,078	12,883	1	Varies	1	.....
†Medical College of Virginia, Hosp. Div.★	Richmond, Va.	.....	2,053	32,512	1	.....	1	46.50
†State of Wisconsin General Hospital★[4]	Madison, Wis.	H. D. Bouman	3,050	38,382	2	7/1	3	25.00

** Mayo Foundation Fellowships — The Mayo Foundation for Medical Education and Research, Rochester, Minn.: Three-year fellowships beginning quarterly leading to the degree of M.S., or Ph.D., with field named from the University of Minnesota in Physical Medicine; stipend $1,110 per year. Address applications to The Mayo Foundation, Rochester, Minn.

The star (★) indicates hospitals that are also approved for the training of interns. All hospitals on the approved intern list are likewise accredited for general residencies which represent general house staff assignments following the internship.

The dagger (†) represents temporary approval, *pending formal inspection*, in accordance with the plan for the temporary approval of residencies in specialties as announced in THE JOURNAL, A. M A., March 2, 1946, p. 586.

4 Residencies open to women.

*** Rep. in part J. A. M. A. 137:71 (May) 1948.

(*Continued from page 422*)

Income:		
Members' dues		$ 4,653.50
"Archives":		
Advertising	$ 5,624.79	
Subscriptions	9,612.55	
Sale of cuts, etc.	419.20	15,656.54
Interest on United States Government securities		437.50
Convention income:		
Exhibits	$ 5,925.00	
Special instruction course	1,985.00	
Total	$ 7,910.00	
Direct convention expenses	5,213.64	
Convention income — net		2,696.36
Miscellaneous		8.49
Total income.		$23,452.39
Expenses:		
Office expenses and salaries	$15,180.26	
Printing expense — "Archives"	10,494.07	
Cuts, half-tones, electros, etc.	1,598.74	
Special meetings	20.00	
Bank exchange	19.48	
Professional fees	555.66	
Loss on doubtful accounts	64.00	
Traveling	160.55	
Cash discount on advertising	53.68	
Miscellaneous	184.09	
Total expenses	$28,330.53	
Less share of office expense billed to:		
Society of Physical Medicine	$ 120.00	
American Registry of Physical Therapy Technicians	7,200.00	7,320.00
Expenses —net		21,010.53
Net income for the year		$ 2,441.86
Surplus at beginning of the year		16,714.14
Surplus at end of the year		$19,156.00

Report on Examination for the Year Ended December 31, 1947

March 30, 1948.

American Registry of Physical Therapy Technicians,
30 North Michigan Avenue,
Chicago, Illinois.

Dear Sirs:

We have examined the balance sheet of the American Registry of Physical Therapy Technicians as of December 31, 1947, and the statement of net income and surplus for the year ended that date, have reviewed the accounting procedures of the Registry and, without making a detailed audit of the transactions, have examined or tested accounting records of the Registry and other supporting evidence by methods and to the extent we deemed appropriate. Our examination was made in accordance with generally accepted auditing standards applicable in the circumstances and included all procedures which we considered necessary.

In our opinion, the accompanying balance sheet and statement of net income and surplus fairly present, in conformity with generally accepted accounting principles applied on a basis consistent with that of the preceding year, the financial position of the American Registry of Physical Therapy Technicians at December 31, 1947, and the results of its operations for the year ended that date.

We submit the following exhibits:

Exhibit —

A — Balance Sheet, December 31, 1947.

B — Statement of Net Income and Surplus for Year Ended December 31, 1947.

Yours truly,
George Rossetter & Co.

Exhibit A

American Registry of Physical Therapy Technicians

(Incorporated in Illinois — Not for Profit)
Balance Sheet, December 31, 1947

Assets

Current Assets:		
Cash on deposit		$ 4,326.20
Accounts receivable — dues	$ 406.00	
Less reserve for possible losses	100.00	306.00
Investment in United States Savings bonds, Series G at cost		14,500.00
Accrued interest		116.65
Total		$19,248.85

Liabilities

Current Liabilities:		
Account payable — American Congress of Physical Medicine	$ 1,340.04	
Accrued federal excise tax	18.00	
Sundry	13.00	
Total current liabilities		$ 1,371.04
Deferred Income:		
Dues collected in advance — year 1948	$ 5,442.00	
Deposits with applications (subject to refund if applications are rejected)	30.00	
Total deferred income		5,472.00
Surplus, per Exhibit B		12,405.81
Total		$19,248.85

Exhibit B

American Registry of Physical Therapy Technicians
Statement of Net Income and Surplus
for the Year Ended December 31, 1947

Income:		
Dues	$ 6,266.00	
Registration fees	4,210.00	
Sales:		
Pins	1,559.40	
Emblems	343.58	
Directory	119.40	
Interest on United States bonds	325.00	
Miscellaneous	11.41	
Total income		$12,834.79
Expenses:		
Share of office expense billed by American Congress of Physical Medicine — office expenses, and salaries	$ 7,200.00	
Printing and multigraphing.	953.63	
Exchange	51.22	
Examinations — supervision and grading	503.85	
Loss on bad debts	248.00	
Professional fees	377.82	
Purchase of emblems	147.01	
Purchase of pins	923.65	
Bond premium	25.00	
Directory	853.21	
Traveling	204.50	
Reporting costs of educational conference	153.40	
Supplies	236.46	
Telephone and telegraph	32.90	
Miscellaneous	84.53	
Total expenses		11,995.18
Net income for the year		$ 839.61
Surplus at beginning of the year		11,566.20
Surplus at end of the year		$12,405.81

Report of Committee on Meeting Place

The Meeting Place Committee wishes to submit the following report. It is felt advisable that the Congress again return to its routine of setting up the meeting date three years in advance. The Committee is unanimous in its opinion that the Congress meet in Cincinnati in 1949. For 1950 and 1951, the cities of Chicago, St. Louis, Boston, New Orleans, San Francisco, Los Angeles and Seattle have been suggested. If the West Coast is out of the question, possibly Denver, Colorado, might be considered. These cities are submitted for consideration by the membership of the Congress so that action might be taken at the annual meeting in September.

The question as to whether or not our meetings might be changed to another date in the early fall has again been raised. The Chairman of the Meeting Place Committee shall obtain information relative to other dates which might be available which would not conflict with other meetings to be submitted to the membership in September for consideration.

Walter J. Zeiter, M.D., Chairman.
Clarence W. Dail, M.D.
Albert A. Martucci, M.D.
Frank H. Ewerhardt, M.D.
Arthur L. Watkins, M.D.

Report of the Committee on Cooperation With the Army, Navy, Public Health Service and Veterans Administration

Cordial and cooperative relationships have continued to exist between the Physical Medicine Services of the Army, Navy, Public Health Service and the Veterans Administration. This specialty has made steady progress in these governmental agencies and there is mutual interest and endeavor between the physiatrists of these agencies in the continued development and expansion of this field along sound scientific lines.

As governmental agencies, the Army, Navy, Public Health Service and the Veterans Administration have objectives in Physical Medicine for accomplishment in an efficient and ethical manner, which are more or less in common one with the other, such as recruitment and training of physiatrists, therapists and other peronnel; the Board certification of the doctors practicing physical medicine in the government service; the establishment of scientific research projects in keeping with current needs and for the steady advancement of this specialty; the development, expansion, and successful administration of residency programs in Physical Medicine (Army and VA), and the recruitment of a sufficient number of residents. With present pending legislation directed toward rearmament, national preparedness and enlargement of the Armed Forces, there is

emphasized the urgent necessity of having excellent Physical Medicine facilities in the medical services of these governmental agencies. This important need is verified by the remarkable contributions made in the medical care of sick, injured and disabled fighting men during World War II.

The Chairman has received reports of progress and recommendations from all the members of the Committee. All reports have been favorable and encouraging.

It has been suggested that it might be well to consider the possibility of expanding the function of this Committee and changing the name to the Committee on Cooperation with Federal and State Governmental Services, or a similar title, so as to include state vocational rehabilitation activities and probably the various state employment services.

Governmental agencies have established affiliation with Class A medical schools and with approved schools of physical therapy and occupational therapy which has made possible excellent teaching programs, initiation of residencies, and organization of clinical practice for therapists. Research is being established at several governmental hospitals and installations under the supervision of qualified physiatrists utilizing the services of capable therapists and trained technical personnel. The emphasis in all therapy is that it be made purposeful, functional and progressive. Vocational objectives are considered in the over-all rehabilitation plan, and the resocialization and adjustment of the patient is a part of the therapeutic program.

Physical Medicine in all governmental services has the same common objectives: (1) to shorten the period of hospitalization and convalescence, (2) to reduce the possibility of readmission, (3) and to return the individual to duty or a job in the shortest possible time.

It has been suggested that a determined publicity campaign, properly and ethically controlled, should be placed before the medical profession and lay population to educate them about Physical Medicine and Rehabilitation. Outside of our own organizations, officials of the American Medical Association, American College of Physicians and American College of Surgeons could cooperate in the matter and assist in coordinating the campaign so that it would receive widespread distribution and attention. Many physicians are not familiar with the services available in Physical Medicine which will help them treat their patients and get them back to work faster.

It has been observed that the Tables of Organization for Physical Medicine for all government hospitals should be made more or less uniform to the fullest extent possible, including physiatrists, physical therapists, occupational therapists, physical reconditioning or corrective therapy personnel and other rehabilitation personnel. For Army hospitals three physiatrists per thousand beds has been recommended; physiatrist ward officers are necessary where Physical Medicine wards are established. It has been recommended that a qualified physiatrist should be on the consultant staff of each overseas theatre surgeon. This same principle could be applied to other overseas hospital installations.

It has been reported that the Tables of Equipment in Physical Medicine of all government hospitals should be reviewed and revised for the purpose of deleting obsolete equipment and including modern diagnostic and therapeutic Physical Medicine and Rehabilitation equipment.

Liaison between civilian and government hospitals has been very good and is becoming even better with the increasing activities, influence and recognition of Physical Medicine as a specialty and as a consultant service. This cooperation has resulted in an excellent interchange of ideas and a broadening of the scope of the professional services in the participating hospitals.

The problem of recruitment of physicians and medical officers interested in Physical Medicine remains a critical one for the government hospitals. However, more interest is constantly being developed so that younger and additional physicians are entering and exploring this field for career possibilities. With establishment of Physical Medicine in the curriculum of an increasing number of medical schools, the development of several residencies in Physical Medicine and the organization of schools of training in Physical Medicine in government services offering intensive courses for varying periods from a few weeks to six or more months, the problem of recruitment may become less acute.

All governmental agencies have cooperated in the development and presentation of scientific exhibits in Physical Medicine when the opportunity presented itself. Various governmental agencies have been represented in the Special Exhibit on Physical Medicine at the Annual Sessions of the American Medical Association in 1946 and 1947, at the Mid-Winter Session in January, 1948, and at the Annual Session in June, 1948. Publication and distribution of pamphlets, books and other visual aids media, including the development of educational and training films, have been done by several of the governmental agencies.

Whereas no special problems have been referred to this Committee the members of this Committee are ready to help in the solution of any difficulties which are within its jurisdiction.

In conclusion, it is evident that considerable progress in the common advancement of Physical Medicine in the various governmental services has been made during the past year.

A. B. C. Knudson, M.D., Chairman.
Ben L. Boynton, M. D.
John H. Kuitert, M. D.
George G. Deaver, M. D.
Arthur E. White, M. D.

Report of the Membership Committee

The Committee on Membership again reports with satisfaction a steady increase in the number of new members from all parts of the United States and abroad. At the meeting of the Congress, Sept., 1947, seventy applicants were elected to membership, with the following geographic

distribution: New York, 13; Pennsylvania, 12; California, 7; Minnesota, 5; Texas, 4; Tennessee, 3; Connecticut, Illinois, Massachusetts and Mississippi, 2 each; Alabama, Colorado, District of Columbia, Georgia, Iowa, Maryland, Missouri, New Jersey, Ohio, Washington, West Virginia and Wisconsin, 1 each; abroad, Turkey, 2, Brazil, 2, Cuba, 1 and Canada, 1.

The membership census on June 1, 1948, showed a total membership was 542, geographically distributed as follows:

State	Number of Members	State	Number of Members
Alabama	2	Nevada	1
Arizona	2	New Jersey	16
Arkansas	4	New Mexico	1
California	32	New York	125
Colorado	6	North Carolina	4
Connecticut	7	Ohio	31
District of Columbia.	20	Oklahoma	4
Florida	4	Oregon	3
Georgia	5	Pennsylvania	62
Illinois	30	Rhode Island	2
Indiana	12	Tennessee	6
Iowa	10	Texas	13
Kansas	5	Utah	2
Kentucky	3	Virginia	6
Louisiana	4	Washington	2
Maine	1	West Virginia	2
Maryland	5	Wisconsin	15
Massachusetts	16		
Michigan	10	Abroad	
Minnesota	14		
Mississipupi	2	Canada	17
Missouri	5	Other	21
Nebraska	5	Address Unknown	5

Membership outside of the United States, totaling 38 was distributed as follows: Canada, 17; Brazil, 4; Australia, England, Mexico, Portugal and Turkey, 2 each; Belgium, Cuba, Denmark, Puerto Rico, Switzerland, Venezuela and Uruguay, 1 each.

At the time of rendering this report the number of new applications pending was 56.

Richard Kovacs, M.D., Chairman.

Robert W. Boyle, M.D.
Herman L. Rudolph, M.D.
Harold Dinken, M.D.
Theodore Stonehill, M.D.

Report American Registry Physical Therapy Technicians

Period Jan. 1 to Dec. 31, 1947

Number registrations completed	467
Number examinations conducted	471

	1947	1946
Number of requests for qualified personnel	385	240
Number of requests for positions	394	420
Number placements completed	81*	60

Certificates Issued According to School of Graduation

Name of School	Number of Graduates Registered
Albany Hospital, Albany	8
Barnes Hospital, St. Louis	9
Boston Univ. (Sargent College), Cambridge, Mass.	22
Brooke Gen. Hospital, San Antonio, Texas	1
Bushnell Gen. Hospital, Brigham City, Utah	1
Univ. Calif. Med Sch., San Francisco	4
College Medical Evangelists, Los Angeles	27
Columbia University, New York City	23
Duke Univ. Sch. Med., Durham, N. C.	10
Fitzsimons Gen. Hospital, Denver, Colo.	2
Harvard Medical School, Boston	21
State Univ. Iowa, Med. Sch., Iowa City, Ia.	9
Percy Jones Gen. Hosp., Battle Creek, Mich.	12
Univ. Kansas, Sch. of Med., Kansas City, Kans.	38
Lawson Gen. Hosp., Atlanta, Ga.	1
Mayo Clinic, Rochester, Minn.	2
Univ. Minn., Minneapolis	35
New York Univ., New York City	38
Northwestern Univ., Chicago	23
O'Reilly Gen. Hosp., Springfield, Mo.	5
Graduate Hospital, Univ. Penna., Philadelphia.	20
Walter Reed Gen. Hosp., Washington, D. C.	14
Baruch Center of Phys. Med., Richmond P. I., Richmond, Va.	53
St. Louis Univ. Sch. of Nursing, St. Louis	7
Univ. So. Cal., Los Angeles	5
Stanford Univ., Stanford Univ., Cal.	39
D. T. Watson Sch. P. T., Leetsdale, Pa.	23
Univ. Wis. Med. Sch., Madison, Wis.	15
Total	467

* (Figure includes placement of one therapist in Japan)

MEDICAL NEWS

Residencies in Physical Medicine

The University of Colorado Medical Center announces the establishment of two additional residencies in physical medicine, Council approved. Graduate training in the Department of Physical Medicine and Rehabilitation utilizes the clinical facilities of the Medical Center affiliated hospitals. These include the Colorado General Hospital, Denver General Hospital, Veterans Administration Hospital, Fort Logan, Fitzsimons General Hospital and the National Jewish Hospital, Denver.

Training is designed to meet the requirements of the American Board of Physical Medicine and is offered for three years.

Inquiries or applications should be addressed to Dr. Harold Dinken, Director of Physical Medicine or to Dr. Frode Jensen, Director of Graduate Education, University of Colorado Medical Center, 4200 East Ninth Ave., Denver 7, Colo.

Pennsylvania Academy of Physical Medicine

A meeting of the Pennsylvania Academy of Physical Medicine was held May 20 at the Philadelphia County Medical Society Building at which time Dr. Temple Fay spoke on "Neurological Problems of Cerebral Palsy." The following officers were elected for the ensuing year: President, Dr. George Morris Piersol; Vice-President, Dr. U. Rumbaugh; Treasurer, Dr. J. H. Hennemuth; Secretary, Dr. H. L. Rudolph; Program Chairman, Dr. Harold Lefkoe.

Tinted Lenses

Despite the fantastic, absurd and untrue claims of the manufacturers of certain tinted glasses, the lighter shades of colored glass — tints that are hardly perceptible — offer little more protection against glare than clear glass. Nevertheless, promoters assert that through their miracle glasses the light is soft, cool and restful, as in a cathedral; work, they claim, is done more efficiently and with greater comfort. These hyperphysical lenses are said to match the complexion; to be inconspicuous yet improve the appearance; even to increase the visual acuity somehow or other; to protect the eyes against the ultraviolet and infrared in daylight, against amounts of energy which no one except the exploiters of these glasses would ever consider harmful; to keep out most of the light which seems to be bad light and let in only the good light. Through these glasses they claim, there are no annoying color disturbances — the makers have produced the impossible, a colored glass without selectivity. They show pictures of persons reading through their wonderful lenses by the light of a lamp in an otherwise dark room — a spotlight; suggesting that inadequate or poorly distributed artificial light is all right if you wear the right tint.

The exploiters of these glasses would have the ophthalmologist consider a tint as a component of every lens he prescribes. This means that for the "visual comfort" of his patient the ophthalmologist would have to order a different shade for every intensity of light indoors and out. The patient would need a photometer and a bag full of tinted spectacles to meet what they suggest as requirements for proper vision.—Rep. J. A. M. A. 17:1098 (April 24) 1948.

Visual Training for Myopia

In 1920 William H. Bates published a book, "Perfect Sight Without Glasses," in which he advanced the hypothesis that visual derangements and refractive errors are due to a deformation of the eyeball resulting from a nervous and muscular strain from the superior and inferior oblique muscles and that the ciliary muscle has nothing to do with focusing the eye. He developed a corrective treatment consisting of eye exercises described as "blinking," "winking," "nose reading," "palming" and "sunning." Established clinical and scientific observations do not support the Bates thesis. Lancaster felt, however, that "buried in a mass of what to the ophthalmologists seem foolish gestures and performances, there are sound and fruitful ideas." Since seeing is only half ocular, according to Lancaster's statement, the other half being cerebral, repetition, practice and exercise are capable of building up a substratum of memories useful for the interpretation of sensation and formation of syntheses which are the larger part of seeing. Duke-Elder pointed out in his review of Huxley's "The Art of Seeing" that visual defects are sometimes muscular in origin, sometimes psychologic. The competent ophthalmologist treats the former with curative exercises, while the psychologic approach is used for the mental aspect. — Rep. J. A. M. A. 17: 1100 (April 24) 1948.

Fiftieth Anniversary Convention of the American Hospital Association

The American Hospital Association will hold its fiftieth anniversary convention at Atlantic City, N. J., September 20-23, 1948. Convention headquarters will be at the Traymore Hotel; meetings and exhibits at the Atlantic City Convention Hall. The theme of the convention will be "Hospitals—Vital to Better Living."

Many allied health and professional organizations and associations are sponsoring educational exhibits based on their organizations' relation-

ships to hospitals. Four hundred and fifty exhibits of the newest in efficient hospital equipment and supplies will also be shown.

Dr. Walter Jerome Lee Joins Staff Medical College of Virginia

Dr. Walter Jerome Lee diplomate of the American Board of Physical Medicine has been appointed to the position of Associate Professor of Physical Medicine in Baruch Center of Physical Medicine of the Medical College of Virginia, which has just been accorded full departmental status in the School of Medicine. Dr. Lee will also serve as attending physician in Physical Medicine to the McGuire Veterans Administration Hospital.

The Department of Physical Medicine will continue the use of the name by which it is now known, Baruch Center of Physical Medicine, and will absorb all special grant activities under a single departmental head. The total group engaged in physical medicine activities at the Medical College of Virginia now numbers thirty professional or technical workers, twelve of these devote full or part time to research.

Harvard Increases Tuition

An increase in tuition for all students at Harvard Medical School and Harvard University Dental School, Boston, was announced April 5. Tuition in both schools, which has been $580 a year since 1945, will be raised to $800 a year beginning in the fall term of 1948. Officers of the two schools assured students that loan funds and scholarships are at hand to assist individuals in meeting the increased cost. Additional scholarship funds will be available next autumn.

Need for Occupational Therapists

The need for Occupational Therapists is urgent. The number of schools has increased in seven years from five to twenty-five but there are still too many unfilled positions in civilian, army, navy, and veterans hospitals.

Occupational therapists especially, are urged to talk about occupational therapy to their friends, colleges, preparatory schools, church and community groups. Tell prospective students of the opportunities which your profession offers.

Civilian hospitals are employing untrained personnel because they cannot obtain qualified therapists. The quota of occupational therapists in Veterans Administration Hospitals is not met yet.

Occupational therapists are now commissioned as officers in the Women's Medical Specialist Corps of the U. S. Army and are eligible for all the rights and privileges of regular Army officers. Here is the opportunity to practice occupational therapy on a high professional level. Further training and advancement, overseas assignments, good salaries with regular increases, provision for maintenance, health protection and retirement benefits are added inducements to service.

Because those therapists who served in Army hospitals during World War II were civilian employees, there has been no opportunity to build a Reserve Corps as is the case in other allied groups. Such a Reserve must be established so that rapid expansion will be possible in case of another national emergency. All qualified therapists should consider applying for a commission in the Reserve Corps in addition to their present civilian commitments.

Rheumatoid Arthritis and the Heart

The problem of rheumatic and rheumatoid arthritis and its relation to the heart is being studied in Brazil, where rheumatism is not such an important etiologic factor of cardiac diseases as in colder climates. Dr. Lucchesi reported the observation of an enlarged left ventricle due to hypertension, causing left axis deviation in 4 cases. He concludes that his observations emphasize the difference between real rheumatic fever and rheumatoid arthritis.

Physical Fitness as Physicians See It

The report of the Subcommittee on Physical Fitness of the Baruch Committee on Physical Medicine rejects the concept that any one set of criteria can successfully predetermine fitness for the wide variety of tasks and activities of modern life. It also repudiates the idea that fitness can be determined on the basis of physical tests or medical examinations alone.

Though this report will be disappointing to the physician seeking a simple answer to the problem of evaluating fitness in his patients, the statement merits serious study. In the periodic health examination the emphasis must be placed "on the dynamic state of the individual, rather than on the anatomic aspects of illness." Accomplishment of this proposal will certainly require both time and effort, but the adaptation of functional tests already developed in the field of physical education, and of the interview technics developed by psychologists and personnel workers, might well facilitate the process.

Medical Service Reserve to Place 300 More Reserves on Active Duty

Authority has been granted to the Army Medical Department to immediately place three hundred additional Medical Service Reserve officers on extended active duty, it was announced by Major General Raymond W. Bliss, The Army Surgeon General. Reserve officers who volunteer will be assigned to duty in all four sections of the Corps, according to their qualifications. The greatest need is in the Medical Allied Science Section which includes personnel trained in psychology, physiology, biochemistry, nutrition, serology and other related medical sciences needed in the Army. The other three sections of the Medical Service Corps are the Pharmacy, Administrative and Supply Section, the Optometry Section and the Sanitary Engineering Section.

BOOK REVIEWS

MANUAL OF FRACTURES AND DISLOCATIONS. By *Barbara Bartlett Stimson,* M.D., Med. Sc.D., F.A.C.S., Assistant Professor of Clinical Orthopedic Surgery, College of Physicians and Surgeons, Columbia University, New York City. New 2nd (Edition). Pp. 223, with 98 illustrations. Price, $3.25. Flexible Binding. Lea & Febiger, Washington Square, Philadelphia 6, Pa., 1948.

This is a second edition of a very valuable book on fractures and dislocations. It is primarily intended for medical students. It consists of 270 pages divided into four parts.

The first part consists of general considerations such as definitions, classification and diagnosis, bone repair, symptoms and signs, principles of treatment of fractures and technic. The other parts deal with fractures of the upper extremity, the trunk and the lower extremity. The chapters are written in didactic manner covering every phase of fractures. All chapters are very clearly written, concise and simple.

The only criticism that might be offered is a neglect of the treatment after the reduction to the final restoration to normal function. The application of physical therapy is rather neglected, sometimes confusing and occasionally misleading.

Although the book is primarily intended for medical students, it can very well be recommended to any physician who deals with fractures.

THE INTEGRATIVE ACTION OF THE NERVOUS SYSTEM. By *Sir Charles S. Sherrington,* O.M. With a new foreword by the author and bibliography of his writings. Cloth. Pp. 433 with 85 Illustrations. Price, $6.00. Yale University Press, 143 Elm Street, New Haven 7, Conn., 1948.

No one in the field of medicine is unfamiliar with the tremendous work and influence of Sir Charles Sherrington. The present volume has been edited by Dr. Samson Wright and is another revised edition of Sherrington's first book of the same title which was published first in 1906, and was immediately acclaimed as a work of outstanding importance. A course of lectures given at Yale University formed the basis for the book. The last edition before the present one was published in 1920 and has been out of print for a generation. The present volume has been entirely reset, misprints have been carefully corrected, and minor doubtful points cleared up. All the figures have been redrawn. Students, teachers and research investigators owe a great debt of gratitude to the Physiological Society for its efforts in promoting the publication of this new edition.

No physiatrist, or physical therapist should be without this book. It is a must. A valuable bibliography of Sherrington's writings from 1884 to 1947 is given as well as his curriculum vitae.

Lectures one to three discuss coordination in the simple reflex; lecture four deals with the interaction between reflexes; lectures five and six discuss compound reflexes, simultaneous and successive combination; lecture seven, reflexes as adapted reactions; lecture eight, some aspect of the reactions of the motor cortex; lecture nine, the physiologic position and dominance of the brain and lecture ten, sensual fusion.

CONCISE ANATOMY. By *Linden F. Edwards,* Ph.D., Professor of Anatomy, The Ohio State University. Cloth. Pp. 548, with 324 illustrations. Price, $5.50. Philadelphia: The Blakiston Company, 1947.

This textbook of human anatomy supplants a former text entitled "Anatomy for Physical Education." It has been thoroughly revised and enlarged in many places; improvements have been added to remedy certain deficiencies and the subject matter has been brought up to date.

It is not a substitute for the more comprehensive treatises on anatomy traditionally used by medical and dental students. It is designed primarily to meet the needs of students in a wide variety of ancillary fields such as physicial therapy, occupational therapy and physical education.

HEADACHE AND OTHER HEAD PAIN. By *Harold G. Wolff,* M.D., Professor of Medicine (Neurology) and Associate Professor of Psychiatry, Cornell University Medical College, Attending Physician, New York Hospital, New York. Cloth. Price, $12.00. Pp. 628, with 154 illustrations. New York: Oxford University Press, 1948.

Headache is one of those discomforts that afflicts practically everyone and for which the practitioner, if aspirin does not relieve, prescribes practically anything. Since head pains are frequently benign, this symptom has never received sufficient and intelligent consideration. This volume certainly takes care of this void. Here is a book that tells everything about headaches — types, cause, mechanism, variations, physiology, symptoms, experimental information, treatments and all its other varied aspects. This book is the result of many years of a tremendous amount of work clinically and in research, of a broad conception of the subject gained from his own scientific efforts together with a correlation and interpretation of the literature, and of the help and cooperation of men in all branches of medicine. In its scope and manner of presentation it has no peer.

The first chapter on "general consideration of pain" is a review of the subject of pain in general. Quantitative determinations, psychologic aspects, anatomical and physiologic variations and

numerous other mechanisms which cause the sensation of pain are discussed. Physiatrists and research workers in physical medicine will be interested in the investigations of pain in skeletal muscles and the explanations of pain which may be relieved or aggravated by physical methods. Suggestions are made for a new approach in the study of the effect of these physical agents.

The next chapter deals with "Headaches caused by the changes in intracranial pressure" and is concerned with observations and explanations of the headaches following experimental drainage of cerebrospinal fluid, following lumbar puncture and that induced by experimentally increasing the intracranial pressure. He concludes with sufficient evidence that "headache is relatively independent of increased intracranial pressure." The studies of post lumbar puncture headache leads to the conclusion that it is caused by dilatation of and traction on pain sensitive intracranial vascular structures. He includes suggestions which will minimize these headaches.

A chapter on headache of cerebral and pial arteries explains lucidly those that are associated with fever, carbon monoxide poisoning, hangover, etc. The author correlates the mechanism of this type of headache with his own work and that of other investigators in the intravenous use of histamine; concluding that it is due to the dilatation of the intercranial arteries plus an increased cerebral blood flow.

In the chapter on "Pain sensitive structures within the cranial cavity" the author reviews the experimental work and clinical evidence for headache caused by pathology localized to this area. The primary factors are inflammation, traction displacement and distention of definite structures either singularly or in combination. His explanation of pain will be helpful in diagnosis.

The description of migraine headaches is a classic. Four chapters of 140 pages cover this syndrome considering the mechanism for the preheadache scotomas, the evidence for the implication of the changes that occur in the extracranial branches of the external carotid artery and the role of the intracranial arteries in the migraine headache itself. All the experimental investigations are reviewed and evaluated. The therapeutic effect of ergotamine tartrate is shown to be related to its action on the amplitude and pulsations of the temporal and occipital arteries rather than on the branches of the internal carotid artery. The use, abuse and contraindications of this drug are given.

Chapters on the headaches due to teeth, sinuses, ears and eyes are included. The author analyzes the experimental evidence for this occurrence coming to the conclusion that these structures are incriminated much more frequently than is justified.

The frequent references to physical medicine both for treatment and in the use of the various electrical currents in experimental work will please and satisfy physiatrists. His recommendations of these methods for their therapeutic effect shows an understanding and appreciation of their value.

The author's phraseology is often unique and many statements are gems. The following are cited as example — for psychotherapy: "One is sometimes left with the notion that reassurance, encouragement, a holiday, hearty laughter and linguistic tricks are the essentials for such therapy"; as a contributing cause for the hangover headache: "sustained effort, loss of restraint and perhaps some remorse" and "though pain always means something wrong, with headache it often means wrong direction or wrong pace — a biologic reprimand rather than a threat."

This book should be helpful to practically everyone interested in the human body — general practitioners, specialists of all types, physiologists, dentists, pharmacologists, sociologists, psychologist and all the rest. The problem of headaches crosses many paths. The author has that rare ability to write clearly and interestingly about difficult subjects. His arrangement of the material, his style of writing and use of words is certainly exemplary. This is a monumental work. This is a real contribution to the medical literature.

The publisher, too, is entitled to credit in producing a book of exceptional typographical merit. The printing is clear, the spacing aids in reading and the illustrations and diagrams are of unusual excellence.

SYNOPSIS OF NEUROPSYCHIATRY. By *Lowell S. Selling,* M.D., Ph.D., Dr. P.H., F.A.C.P., Director, Division of Mental Health, Florida Department of Health; Formerly, Attending Neuropsychiatrist, Deaconess Hospital; Associate Attending Neuropsychiatrist, Mt. Carmel Mercy Hospital, and Wayne County General Hospital; Director, Psychopathic Clinic, Recorder's Court, Detroit, Michigan; Assistant Professor of Criminology, Medical Jurisprudence and Social Hygiene, University of Illinois College of Medicine; Lecturer in Psychology, Wayne University; Visiting Professor of Psychology, Iowa State College. Second Edition. Illustrated. Cloth. Pp. 561. Price, $6.50. St. Louis: The C. V. Mosby Company, 1947

Unless one is completely averse to the synopsis type of text, this should be considered an excellent short summary of neuropsychiatry. The chapters on Neurology are divided according to anatomical distribution. Basic anatomy, physiology and pathology are considered first; then outlines of the clinical syndromes. A valuable addition would be more illustrations of pathologic and clinical features and anatomical diagrams.

The second half of the book on mental disorders is introduced by a chapter on abnormal psychology including mechanisms of adjustment and a brief sketch of psychoanalytic dynamics. The most familiar psychiatric symptoms are described systematically with emphasis on the conditions related to known traumatic, toxic and degenerative etiology. The clinical pictures are drawn as adequately as possible in this type of

presentation, but without illustrative case histories it is doubtful if the student can learn very much of practical clinical value.

Psychosomatic medicine and behavior disorders of children are discussed in the final chapter. The bibliography consists largely of references to standard textbooks. This book is recommended for review and examination purposes or as a quick reference text for those rarely dealing with neuropsychiatric problems. The specialist in the field will find it of limited value.

THE PHYSICAL TREATMENT OF INJURIES OF THE BRAIN. By *K. M. Hern,* M.C.S.P., Diploma of Liverpool Physical Training College, In Charge of Physiotherapy Department, Military Hospital (Head Injuries), Oxford. Cloth. Pp. 96, illustrated. Price, $4.00. Baltimore: The Williams & Wilkins Co., 1947.

This short text presents a philosophy of treatment of hemiplegia and other upper motor neurone disorders based on the principle of stimulating the patient to active motion of the affected parts. The methods employed are described in full detail and with appropriate illustrations.

Methods of teaching walking and rhythmic lower extremities exercises with minimal apparatus are first described.

For the upper extremities three sizes of balls are used to develop control by rhythmic bouncing and juggling games and exercises. Wall bars are used for both arm and leg motions, particularly for balance and control in the case of ataxia. Other apparatus advocated includes standard wrist roll and pronator-supinator machinery and a narrow elevated bench for walking balance. Certain types of occupational therapy procedures are also included.

Although the methods of reeducation expounded cannot be considered new or revolutionary, there is much of practical value to be found here even for the experienced technician. It should be a very valuable text for the student physical therapist or physiatrist.

THE TREATMENT OF DIABETES MELLITUS. By *Elliott P. Joslin,* A.M., M.D., Sc. D., Medical Director, George F. Baker Clinic, New England Deaconess Hospital; Clinical Professor of Medicine Emeritus, Harvard Medical School; Consulting Physician, Boston City Hospital. *Howard F. Root,* M.D., Physician-in-Chief, New England Deaconess Hospital; Consultant in Medicine, Eastern Maine General Hospital; Massachusetts State Infirmary, Tewksbury, Middlesex County Sanatorium; Associate in Medicine, Harvard Medical School. *Priscilla White,* M.D., Physician, New England Deaconess Hospital; Instructor in Pediatrics, Tufts College Medical School. *Alexander Marble,* A.M., M.D., Physician, New England Deaconess Hospital; Instructor in Medicine, Harvard Medical School; Colonel, Medical Reserve Corps, U. S. Army; Chief, Section of General Medicine, Branch No. 1 (New England), Veterans Administration. *C. Cabell Bailey,* M.D., Physician, New England Deaconess Hospital; Research Fellow in Medicine, Harvard Medical School. Eighth edition. Cloth. Pp. 861. Price, $10.00. Philadelphia: Lea & Febiger, 1947.

This is truly a complete text on the subject of diabetes based on the experience of an outstanding expert and his associates in treating 29,000 diabetics in forty-eight years. The 861 pages in 31 chapters bring up to date information on all the various aspects of the disease including physiology, pathology, the numerous complications and treatment. Our knowledge of the nature of the disease and ability to treat it are well shown by statistical methods and success is indicated by the fact that insurance companies are now beginning to issue insurance to diabetics.

Although much of the data is presented in tables, the style of writing, particularly of the senior author, holds the interest of the reader. This is an authoritative work by a group of experts who present observed facts in sufficient detail to serve the research worker as well as the general practitioner. This book is unhesitatingly recommended as one of the most outstanding medical texts of the time.

THE SAUNA (IN GERMAN). Its History — The Basis of Its Effects, Its Employment for Prophylaxis and Treatment. With an Appendix: Construction and Administration of the Sauna. By Dr. Med. *Victor R. Ott,* Private-Docent of the Medical Faculty of Zurich. Pp. 224, with 29 illustrations. Price, $4.50. Benno Schwabe & Co., Basel. Imported by Grune & Stratton, Inc., 381 Fourth Ave., New York 21, 1947.

The original Sauna bath consists of an oven in an enclosed room in which steam is generated by sprinkling water from time to time over the hot stones, thus creating an atmosphere saturated with hot air and steam. It has been originated in Finland, but since the 1936 Olympic games has found considerable interest outside of Finland, notably in Switzerland. The Institute for Physical Therapy of the University of Zurich opened in 1941 the first public sauna bath and there are at present some 150 such public steam baths of various construction in operation throughout Switzerland. This volume offers a scholarly presentation of the entire subject, its major divisions being: Historical review; The effects of a sweat bath; Personal experiences with the sauna; Experimental basis of the sauna effect; The empirical effects of sauna in the light of experimental results; Indications and Dosage of the sauna bath. It is stated that the Sauna constitutes a typical "reaction therapy," reawakening the much neglected natural reaction to general thermal stimuli. It is recommended in the healthy individual for recreation and for increase of accomplishment in training; also for prophylaxis against colds, especially those of the upper respiratory tract. In treatment, a single sauna bath is claimed to be beneficial in acute catarrh of the upper respiratory tract; while regular baths once or twice a week should be indicated in subacute and chronic catarrhs of the respiratory tract; in poorly healing

infected wounds, in endocrine disturbances, neurovegetative disorders and some chronic dermatoses, such as psoriasis and urticaria. The appendix furnishes a detailed description of the construction, operation and technic of administration, as well as a complete bibliography. This is a valuable monograph on the physical and physiologic basis of a form of systemic physical treatment which hitherto has received no basic consideration at all and which has important bearing on sport, military and general hygiene. It offers useful and interesting information to physicians and other interested persons who can read German.

PSYCHOBIOLOGY AND PSYCHIATRY. (A Textbook of Normal and Abnormal Human Behavior.) By *Wendell Muncie,* M.D. Practicing Psychiatrist; Chairman, Medical Advisory Board, Seton Institute, Baltimore, Md.; Associate Professor of Psychiatry, Johns Hopkins University; Consultant in Psychiatry, U.S.V.A. Second Edition. Pp. 620, 70 illustrations. Price, $2.75. St. Louis: The C. V. Mosby Company, 1948.

This volume is written by an associate of Dr. Adolph Meyer, an acknowledged leader in American psychiatry for almost half a century. It gives a comprehensive account of the concepts, teaching and working methods of the Henry Phipps Psychiatric Clinic at the Johns Hopkins Hospital of Baltimore. It is divided into three parts: Part 1, psychobiology, the study of normal behavior; part 2, abnormal behavior, pathology and psychiatry; and part 3, treatment. In the preface of the second edition the author points out that in spite of the immense expansion of the areas of acceptance of psychiatry, there is still too much heat and too little light in the discussions of psychiatrists. Case observation leads to generalization, generalization to rigid systematization, systematization to belief and belief to intolerance, and intolerance to ambition to control teaching policy and the few facilities for hospital treatment. At a time when many methods may demonstrably produce helpful results, it is utterly shortsighted for traditionalists to deny the usefulness of psychoanalysis, for psychoanalysts to refuse to accept the usefulness of shock therapy and all together to condemn prefrontal lobotomy! He also states that in this volume little use has been made of statistical studies. This has been deliberate, for, in a field where every item is open to question and sorely in need of better definition, statistics would appear to be of secondary importance for the student.

Since the appearance of the first edition, the author has devoted himself chiefly to private practice and consequently has endeavored to indicate in the new edition what he found useful as concepts and as practice. Among the therapeutic aids the author briefly describes hydrotherapy, but no other physical therapy method. Sixty-eight illustrations, a number of tables and extensive bibliography at the end of each section add to the instructiveness of the presentation.

A SYNOPSIS OF ORTHOPAEDIC SURGERY. By *A. David Le Vay,* M.S. (Lond.), F. R. C.S. (Eng.), Honorary Orthopaedic Surgeon, Woolwich Memorial Hospital; Late Surgical Registrar, Royal National Orthopaedic Hospital; Late Senior Surgeon, Ministry of Pensions. Fabrikoid. Pp. 242, with 55 illustrations. Price, 15s. net. H. K. Lewis & Co., Ltd., 136 Gower St., London, W. C. 1, 1947.

This summary of orthopaedic surgery fills a definite need for use in the education of physical therapists, occupational therapists, medical students and physicians such as the physiatrist confronted with orthopaedic problems but who are not concerned with the technic of orthopaedic surgery.

The clinical and pathologic features of all the common lesions of bones and joints are outlined succinctly but with surprising completeness for such a short text. The methods of treatment available have in general sufficient detail for the purpose of this book. The line drawings are good and add appreciably to the understanding of the lesions and operations illustrated.

In the way of constructive criticism for future editions certain suggestions are made. A glossary of terms would be valuable; also a short selected bibliography. More cross references in the chapters on local areas to the earlier general discussions would increase usefulness for reference purposes. A number of small points may be open to question; for example: cerebral spinal fluid protein "up to .1 or .15 mg." without normal figures for method of quantitation used (p. 91); mention of only erector spinae exercises in treatment of lumbrosacral strain (p. 92); physiotherapy is frequently spoken of as separate from exercises whereas in this country we consider therapeutic exercises one of the most commonly used procedures of physical therapy. That physiotherapy is not helpful in Sudeck's atrophy (p. 130) is open to debate.

In the discussion of the treatment of poliomyelitis rigid splinting in the convalescent stage is advocated, also electrical stimulation, a curious mixture of old and new ideas on therapy. That "motor fiber regeneration" is the explanation of recovery from paralysis is not generally accepted and the terms are ambiguous. The section on spastic paralysis deals only with cerebral palsy and might well be enlarged.

In spite of the few defects noted, this book is well recomemnded, particularly for physicians and technicians in the field of physical medicine.

PHYSICAL MEDICINE ABSTRACTS

Physical Medicine in the Treatment of the Aged. Walter S. McClellan.

J. A. M. A. 137:130 (May 8) 1948.

In peripheral vascular disease, particularly associated with arteriosclerosis, numbness, tingling and the usual symptoms resulting from diminished circulation in the extremities are reported. The physician may say "Well, apply some heat to the extremities." Without careful specification of the type and amount, the patient overdoses the application, resulting at times in severe burns. Heat is of value but only in distinct moderation and applied in such a manner that there is no possibility of raising the temperature of the extremity beyond the temperature of the body. It is best applied in a heat cradle or baker with a thermostatic control. Gentle applications of infrared heat are useful but again must be carefully checked not to overheat an extremity. The use of hot packs, mud packs, diathermy and even baths above a temperature of 96 F. may be detrimental. There is value for these patients in heat, but it must be moderate. It also is important that the form of heat used shall be available for considerable periods of time.

Contrast baths, namely, the exposure of the extremity to hot water and then to cold water, have been suggested by some writers, but Wright in his recent review of the problem, expressed the opinion that this procedure is dangerous for these patients. The author would agree that they do not respond well to sudden changes of temperatures as well as activity, avoiding the extremes of either heat or cold.

Physical Medicine in the Treatment of Fractures. Miland E. Knapp.

J. A. M. A. 137:136 (May 8) 1948.

Treatment for these conditions should be started immediately after the fracture is reduced and immobilized. At first the treatment should be directed mainly toward the removal of hemorrhage and edema. This may be accomplished most efficiently by active exercise. Normal venous return flow circulation from the extremities is accomplished through muscle contraction. By careful choice of the immobilizing apparatus, active motion of some portion of the extremity is usually feasible throughout the period of immobilization. Close fitting, nonpadded plaster casts, trimmed so that motion is possible in all joints except those required to maintain the immobilization, are usually satisfactory in those patients that are ambulatory. Skeletal traction and internal fixation in the more serious cases allow adequate immobilization of the fracture line with minimum immobilization of surrounding joints. Elevation of the affected part is a useful adjunct in removal of swelling. However, it must be remembered that for elevation to be effective, the extremity must be so arranged that there is a continuous downhill slope from the fingers or toes to the body. This means in the upper extremity that the hand must be above the elbow and the elbow above the shoulder. Obviously this is not a practical position unless the patient is in bed. The use of a sling in a Colles fracture, for instance, does not prevent swelling because an uphill grade is still present between the elbow and the shoulder. If adequate activity or elevation or both can be accomplished immediately after the fracture has been reduced the problem of removal of swelling has usually been solved and routine care in the department of physical medicine will be reduced to a minimum.

The physiologic effects of massage vary with the type and dosage employed. However, as used in the early treatment of fractures (superficial stroking) the effects are: (1) sedation and relief of pain and muscle spasm; (2) increase of circulation, this time the greatest effect is on the venous side of the circle so that return flow is facilitated both reflexly and mechanically; (3) subsequent decrease of swelling because of the increased venous circulation.

Wherever voluntary active motion may be impractical or impossible, as in nerve injuries, the use of electrical stimulation will help to prevent muscle atrophy and circulatory dysfunction. The faradic current may be used if the nerve is intact, but the interrupted galvanic or sinusoidal current must be used if the nerve is severed and the nerve endings are degenerated.

Active motion of all joints not necessarily immobilized must be insisted on between treatments throughout the course of fixation if muscle atrophy and fibrosis are to be prevented and limitation of motion is to be kept at a minimum.

While recreational therapy is useful when the patient is in bed and has a limited usefulness during early convalescence, vocational methods appear to be much more valuable when the patient is in the later convalescent stages. The tendency at the present time is to emphasize the vocational methods and to reemphasize recreational occupational therapy.

Physical Treatment of Common Dermatologic Lesions. Anthony C. Cipollaro.

J. A. M. A. 137:35 (May 8) 1948.

Ultraviolet rays have been found useful in a large number of diseases of the skin, the most important of which are acne vulgaris, dermatophytosis, neurodermatitis, eczema in infants, ec-

zema seborrheicum, furunculosis and folliculitis, pityriasis rosea, parapsoriasis, essential pruritus, psoriasis, tuberculodermas, including lupus vulgaris, serofuloderma, erythema induratum and orificial tuberculosis, and some slowly healing ulcers which consists of the application of crude coal tar ointment prior to exposure to ultraviolet rays, has been found particularly efficacious for this stubborn and recalcitrant disease.

It is necessary to emphasize that ultraviolet rays should never be used in the treatment of lupus erythematosus because after an intense reaction some cases of discoid lupus erythematosus may become generalized and terminate fatally.

The galvanic current is used for common ion transfer especially for the treatment of dermotophytosis, pompholyx, nummular eczema, varicose ulcers, scleroderma and Raynaud's disease. In dermatology, the galvanic current is used mostly for the destruction of such lesions as hypertrichosis, telangiectases, nevi, keratoses, adenoma sebaceum, benign cystic epitheliomas and verrucae.

Physiotherapy in Poliomyelitis.

Brit. M. J. **4553**:700 (April 10) 1948.

"The Role of Physiotherapy in the Treatment of Poliomyelitis" was the subject under discussion at a meeting of the Section of Physical Medicine of the Royal Society of Medicine.

Dr. F. S. Cooksey reviewed the subject in the light of the epidemic of 1947. As yet there was no specific prophylactic or cure for the disease; therefore, it was not surprising that promising new methods of treatment were tried, sometimes with the haste which led to exaggerated claims. He supported Seddon's view that no one had ever cured a case of poliomyelitis; all that could be done was to help a process of recovery which was outside their control. Seddon, of course, was referring to the treatment of the disease after the virus had invaded the central nervous system. Dr. Cooksey considered the disease in three stages: (1) the inflammatory phase; (2) the stage of potential recovery and (3) the stage of chronic disability.

It was important to distinguish the purpose of physical therapy at each stage. The danger was that physical therapy would be too vigorous and meddlesome in the beginning and ineffective at the end. Physical activity of any kind after the onset of infection increased the risk of paralysis.

Aural Electrophoresis of Prostigmin. E. Neuwirth.

Med. Record **161**:92 (Feb.) 1948.

It was pointed out that the therapeutic efficiency of prostigmin may hinge on its ability to stimulate the intrinsic muscles of the ear. The vasodilating properties of this drug also received attention.

With the passage of time, increasingly contradictory publications appeared on the treatment of deafness with prostigmin injections. In spite of conflicting reports, it was felt that an attempt should be made to introduce prostigmin by electrophoresis into the aural tissues in the aforementioned conditions. For this purpose, the ear electrode described was designed. Aural electrophoresis should be performed by otologists who alone can evaluate this form of therapy, or by physiatrists who work in close cooperation with otologists.

Treatments are given three times a week. In the average case, a series of six to twelve applications is usually sufficient to indicate therapeutic benefit or the lack of it.

This technic of aural electrophoresis of prostigmin was followed in five patients. Three patients had impaired hearing; two of them had associated tinitus. Two patients had tinitus only. In all patients the auditory disturbances were present for a period less than eight months.

All patients were improved, except one with tinnitus. In view of the small number of patients, the favorable responses cannot be considered conclusive, nevertheless the definite beneficial effect on hearing and the relief afforded patients with tinnitus are encouraging enough to warrant further use and study of aural electrophoresis of prostigmin.

Practical Consideration in the Management of of Arthritis. Richard H. Freyberg.

Pennsylvania M. J. **51**:729 (April) 1948.

The following warnings are emphasized: Although gouty arthritis affects the small joints at the ends of the extremities, especially the great toe (podagra), the toe joints may not be affected until late in the disease and in 10 to 20 per cent of cases are never involved. Other conditions may cause painful inflammation of the proximal great toe joint, especially a bunion with overlying bursitis, and rheumatoid arthritis. Hyperuricemia may occur with other diseases in the absence of gout. In some cases of gout elevated blood uric acid is not observed in repeated examinations until late in the disease, or never. Thus, although frequently helpful, diagnosis cannot hinge on blood uric acid studies. Demonstration of a tophus is pathognomonic of gout, but this may be difficult or impossible.

Function of the Cruciate Ligaments of the Knee-Joint. Arthur J. Helfet.

Lancet I, **6505**:665, 1948.

It is suggested that the cruciate ligaments act as guide ropes rather than check ropes. Rotation of the tibia on the femur is the movement controlled. In the unstable knee the cruciate ligaments and at the least part of the medial ligaments are torn. Loss of stability due to tears of these ligaments may be compensated by extra-articular tendon transpositions. A dislocated "bucket-handle" cartilage prevents final "screwing-home" of the knee-joint in extension, thus leaving the medial femoral condyle protruding over the line of the tibia when the knee is straight. This gives a simple and accurate clinical sign for the displaced cartilage.